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(54) **SURGICAL FASTENER APPLYING APPARATUS**

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(58) **Field of Classification Search**

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See application file for complete search history.

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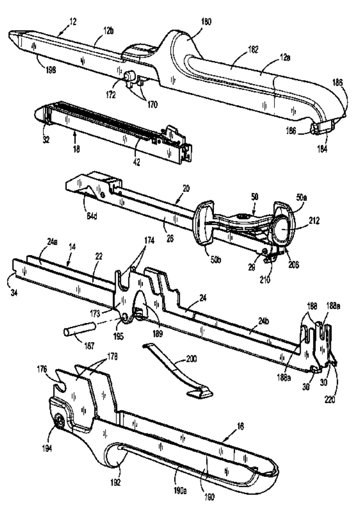
(57) **ABSTRACT**

A surgical fastener applying apparatus for applying fasteners to body tissue. The apparatus includes an anvil half-section having a distal anvil portion and a proximal handle portion and a cartridge receiving half-section having an elongated channel member. A firing assembly is releasably supported in the cartridge half-section and includes a locking member. A clamping lever having an engagement member engages a latch portion of the locking member to releasably retain the clamping lever in a clamped position.

**18 Claims, 27 Drawing Sheets**



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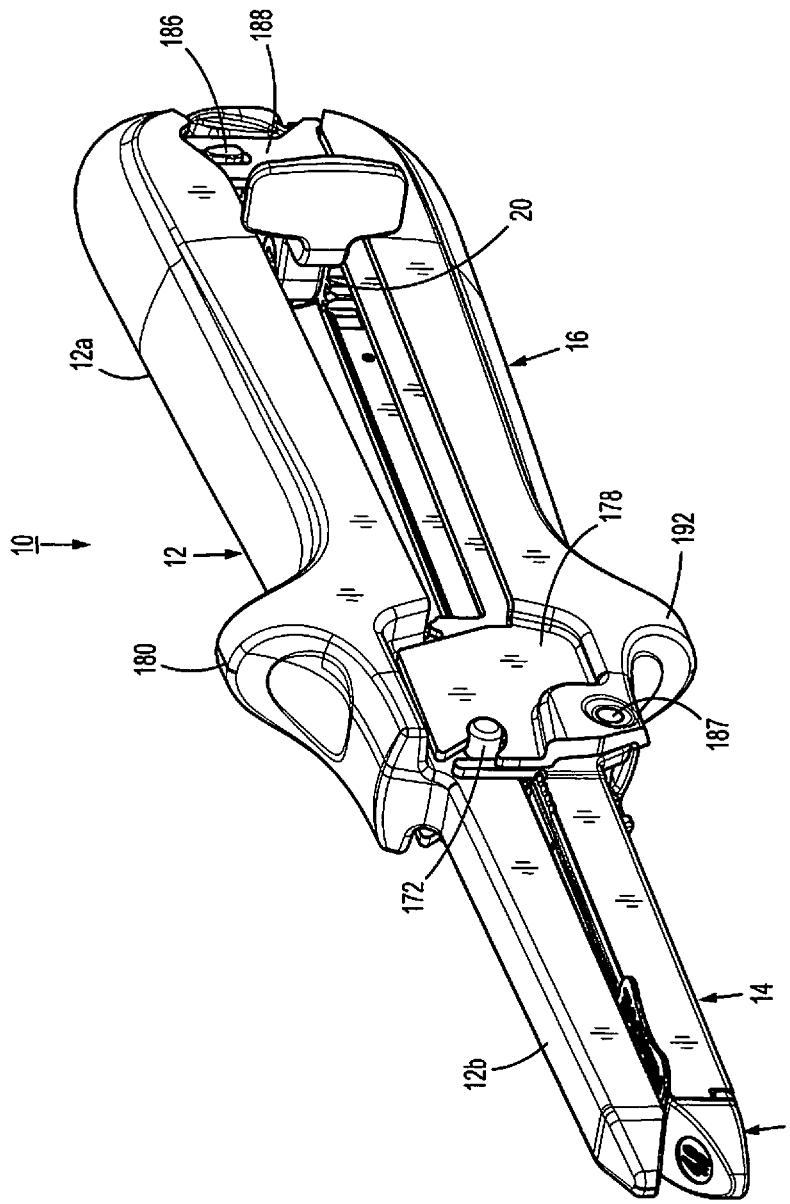


FIG. 1

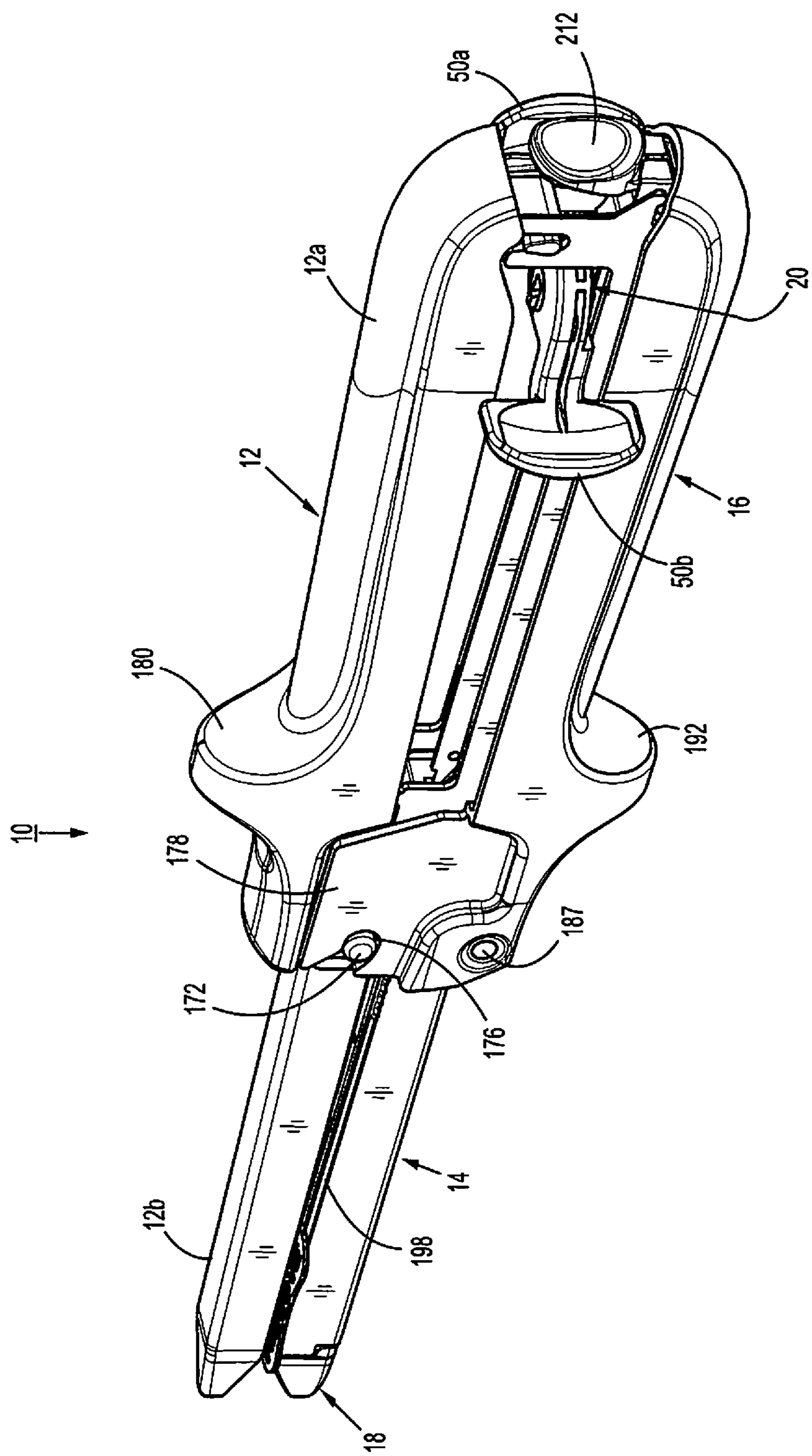


FIG. 2

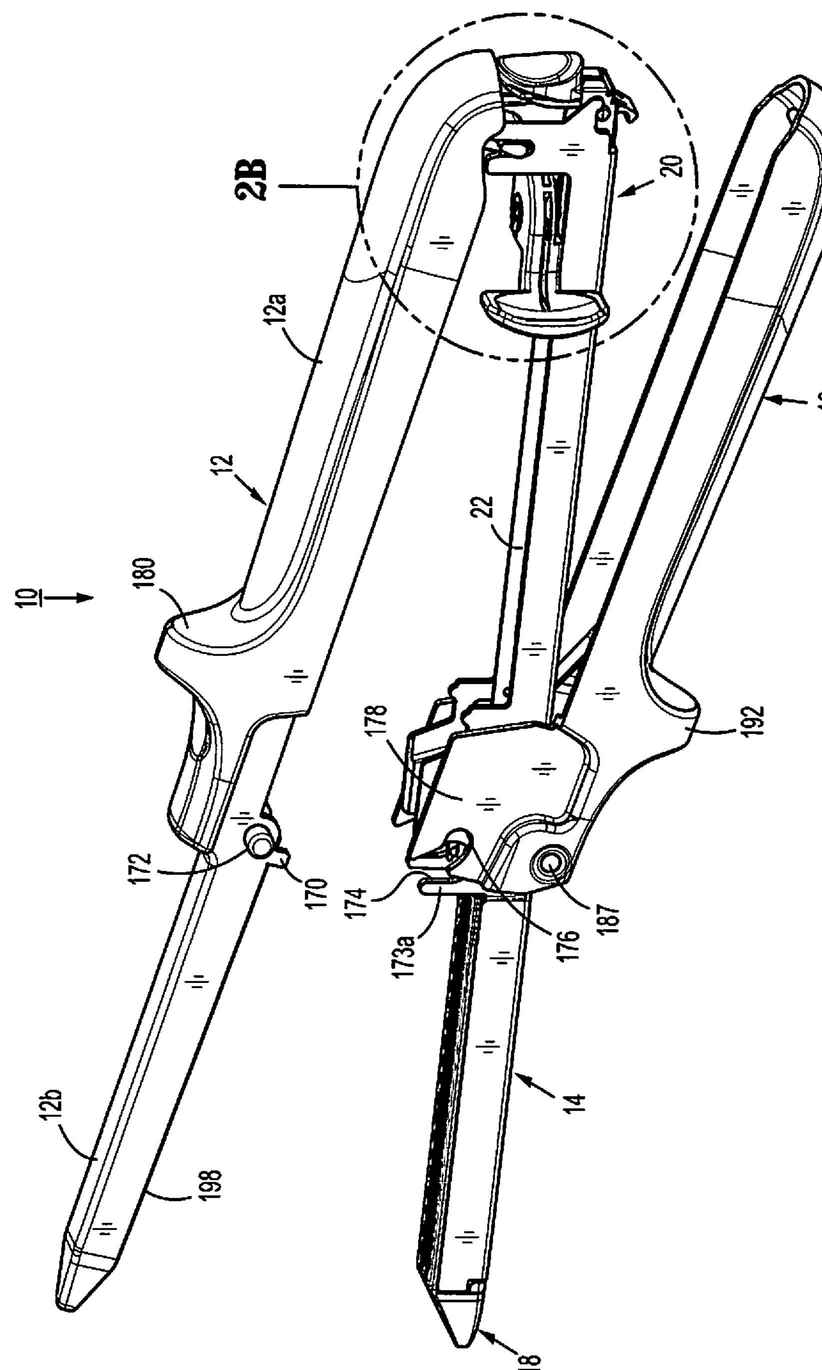
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FIG. 2A

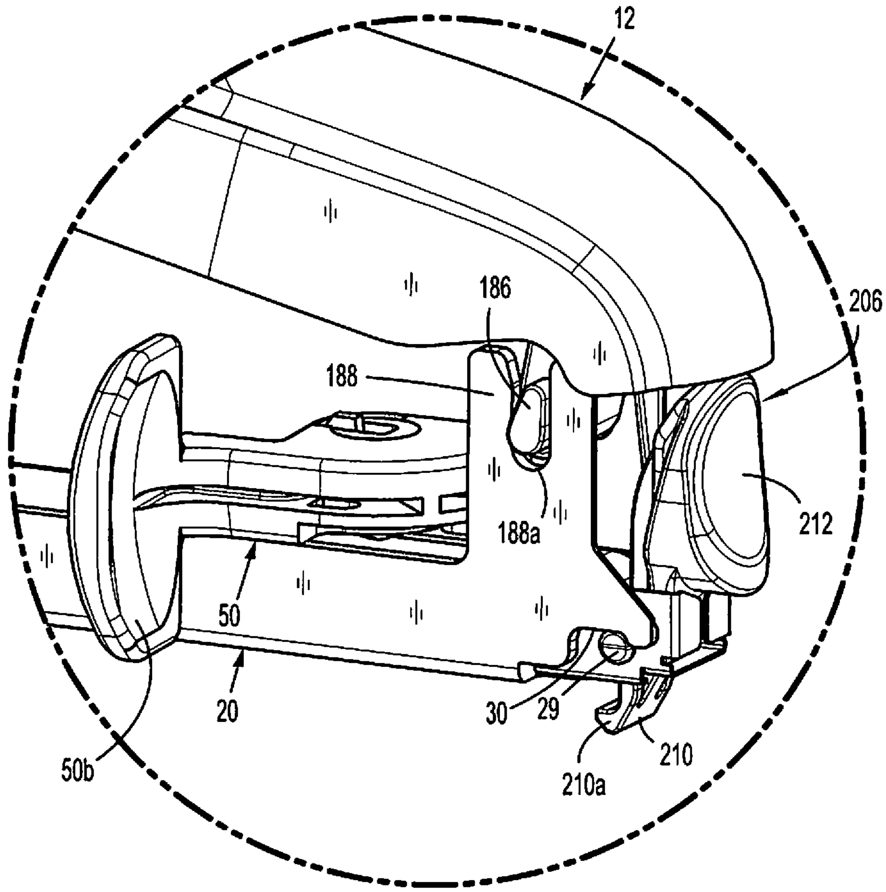
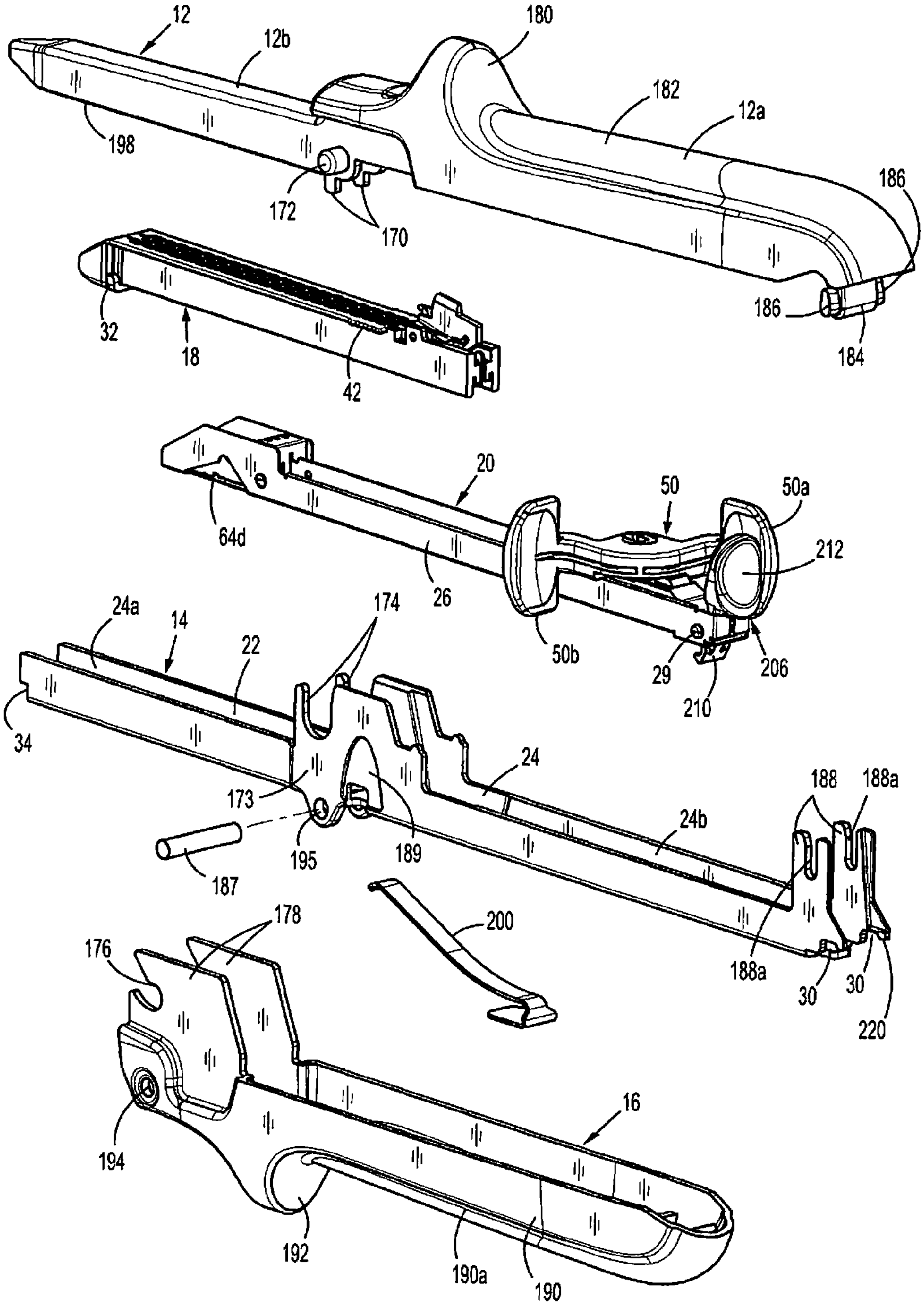



FIG. 2B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206
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24a
14
22
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34
24
173
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30
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190a
190

FIG. 3

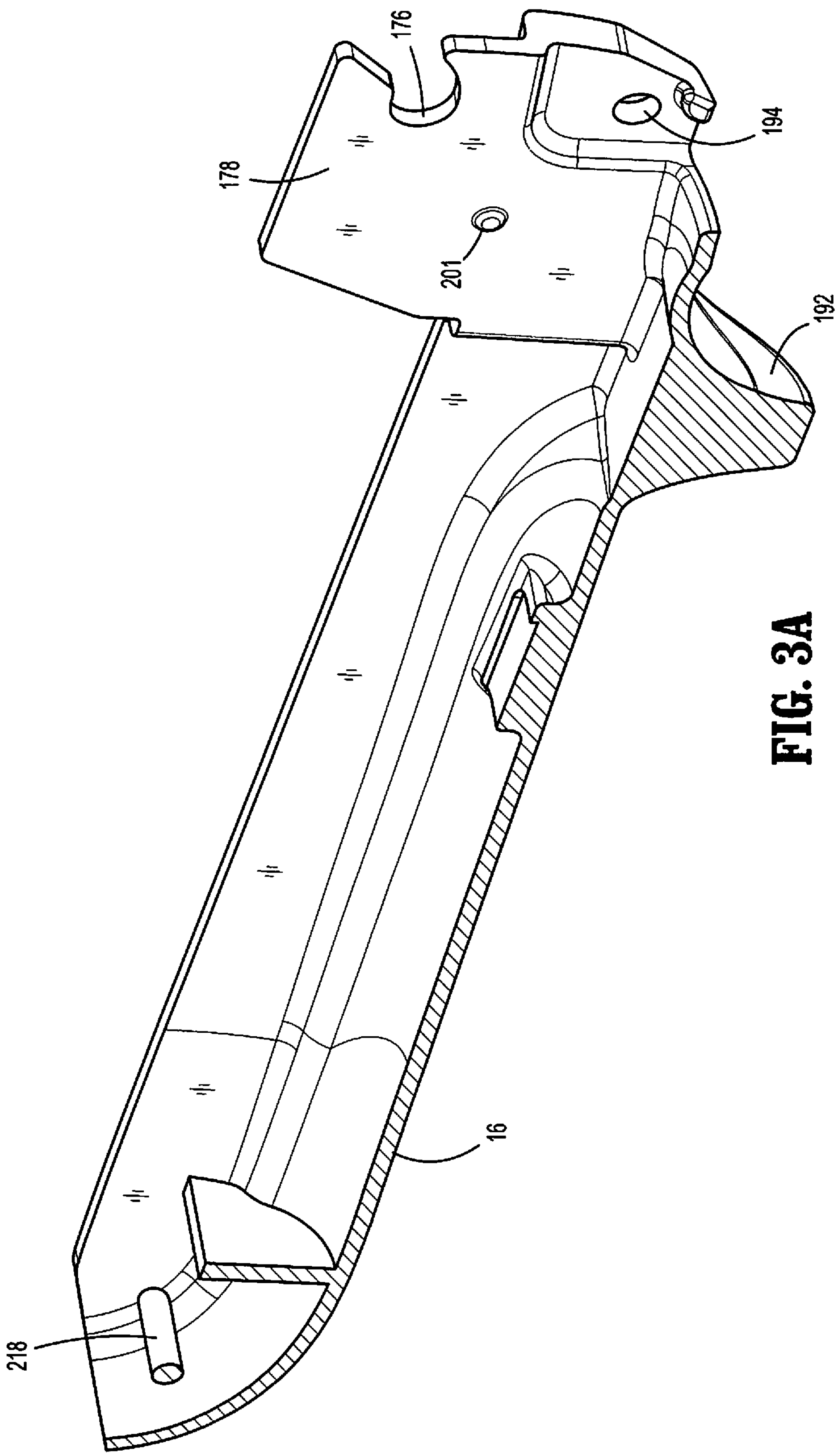


FIG. 3A

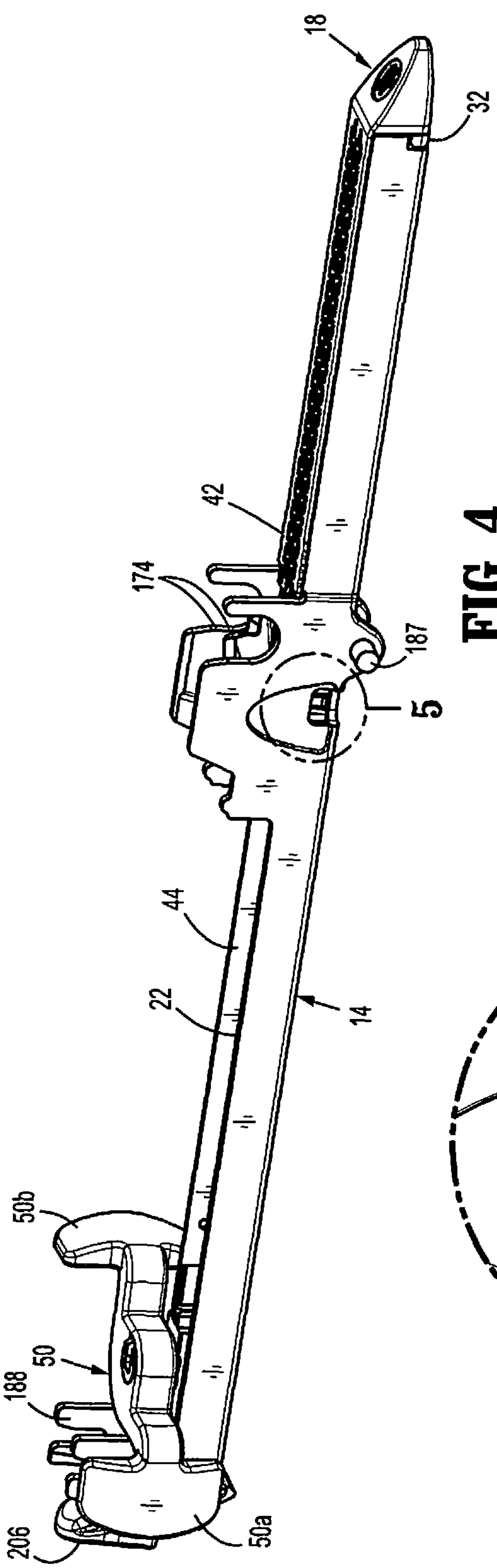


FIG. 4

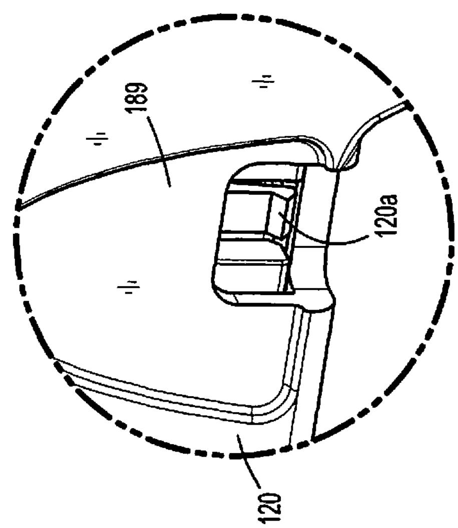


FIG. 5

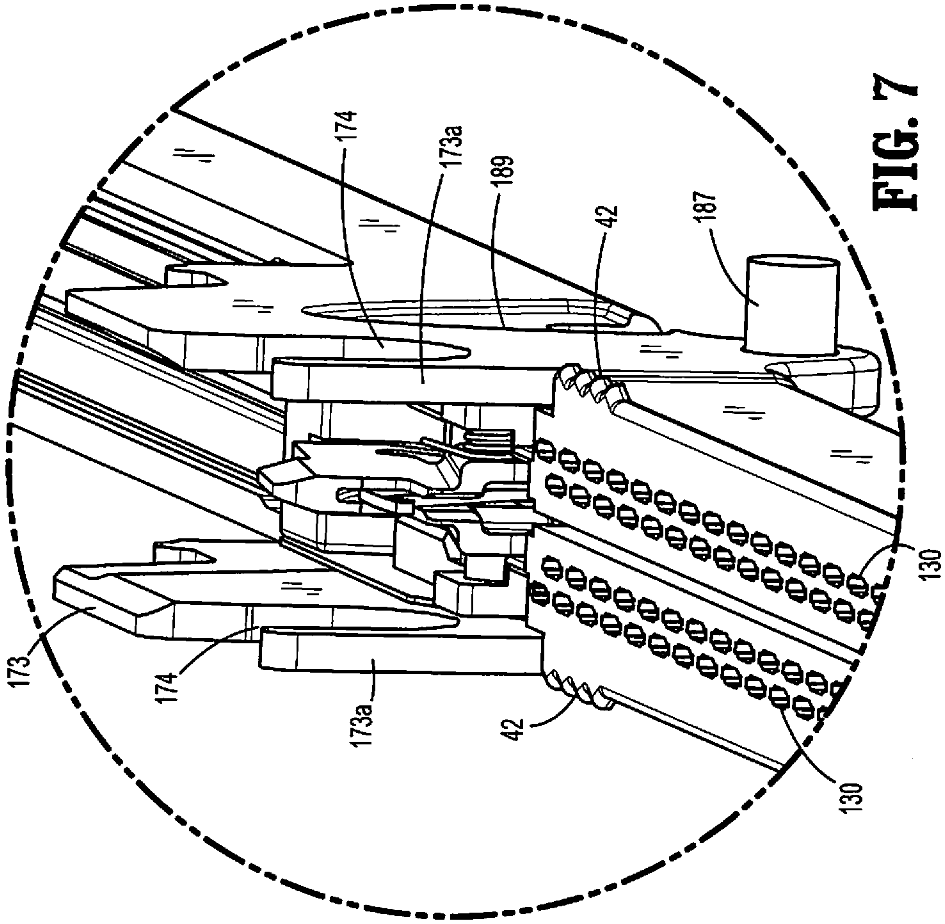
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FIG. 7

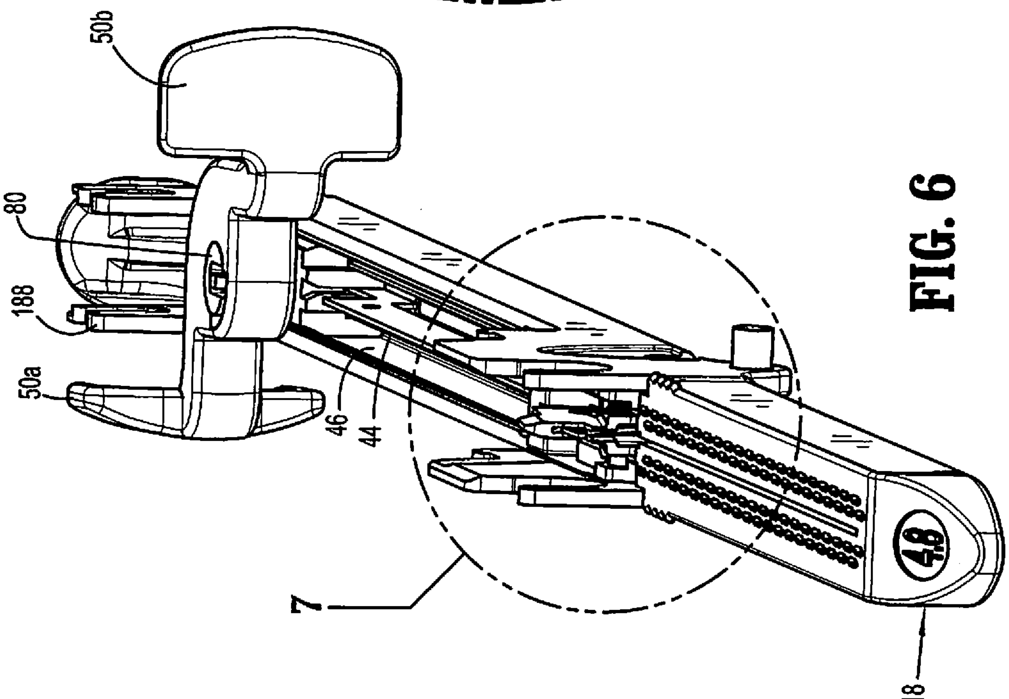
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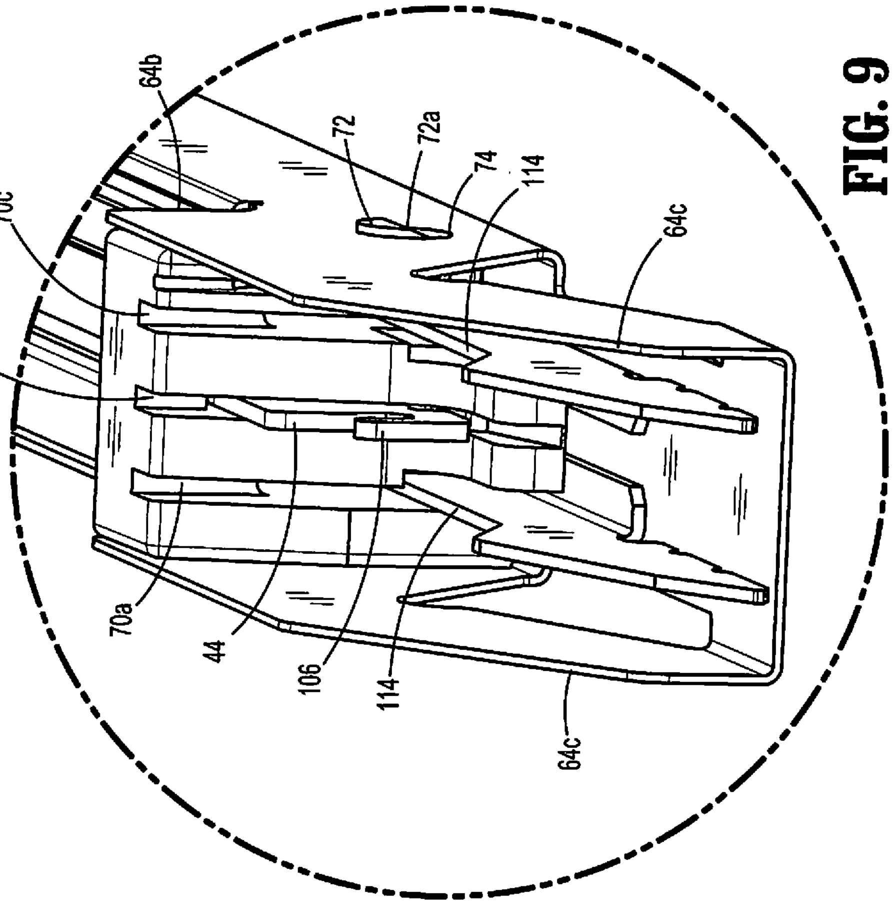
FIG. 6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70a
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FIG. 9

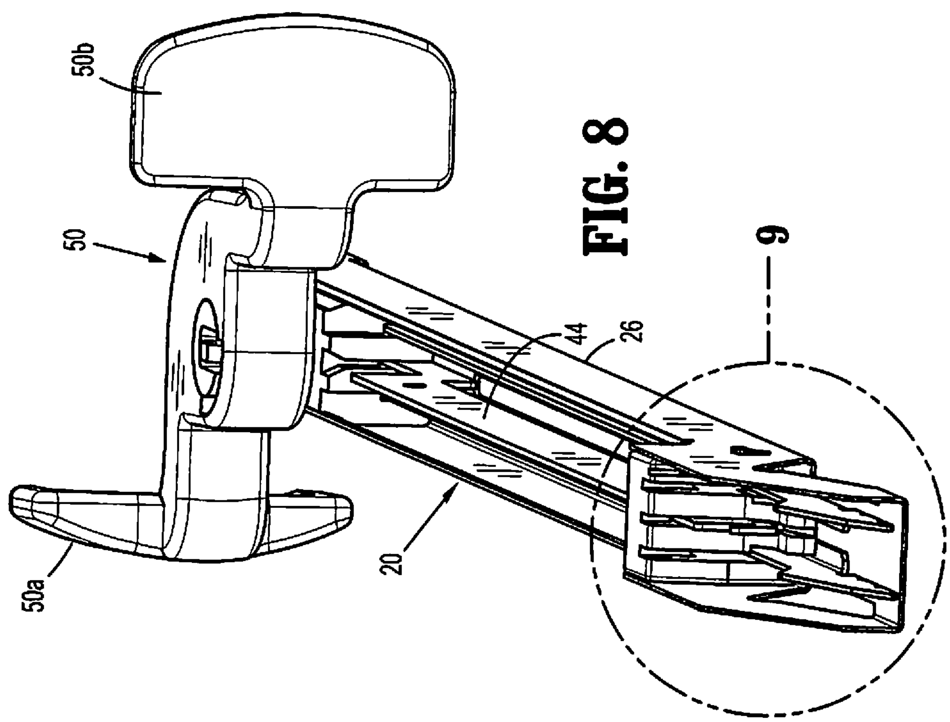
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FIG. 8

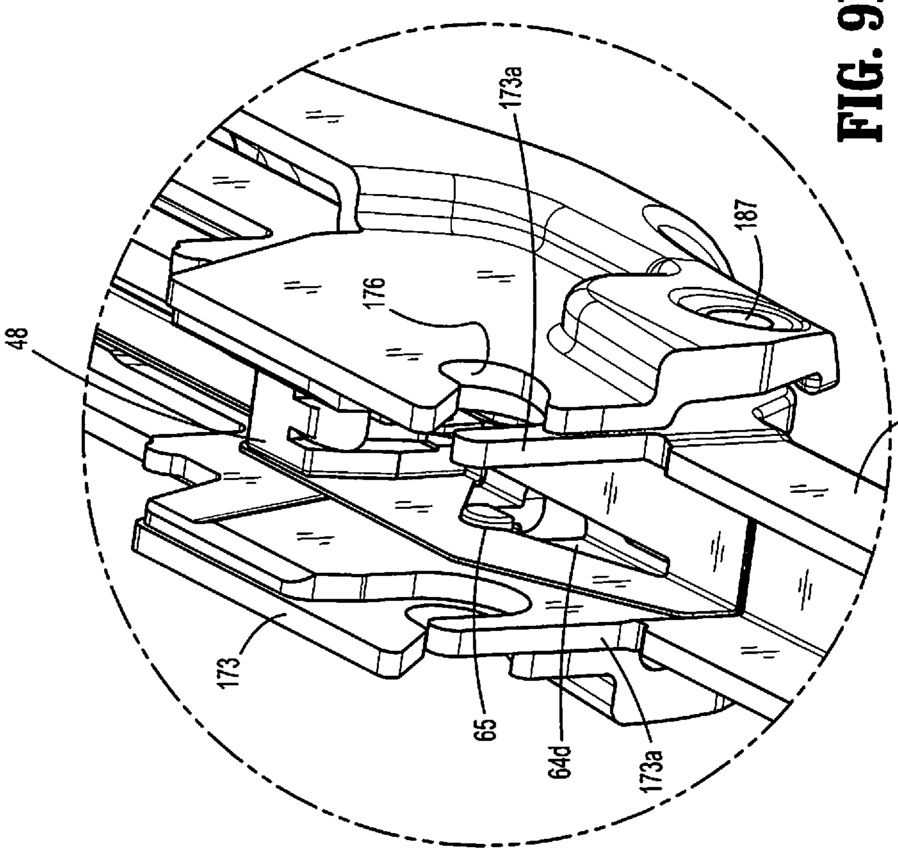



FIG. 9B

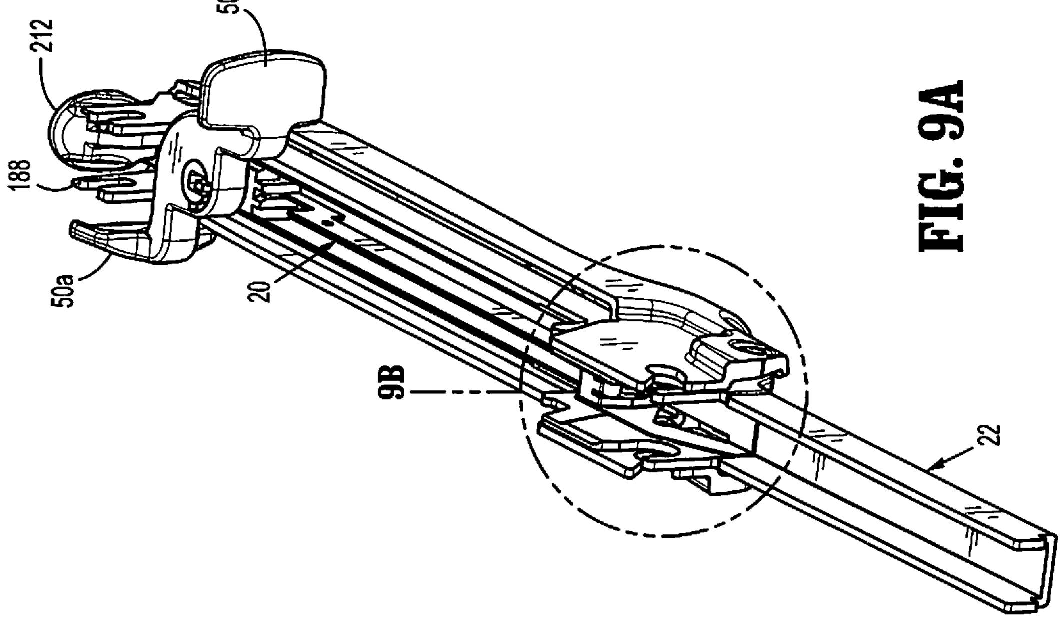



FIG. 9A

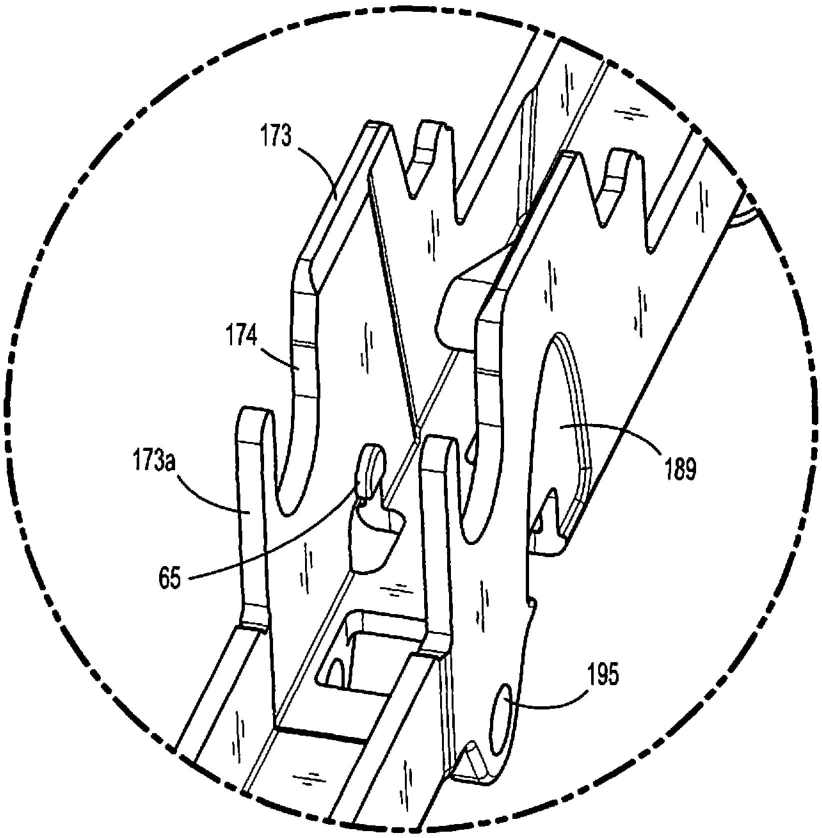



FIG. 9C

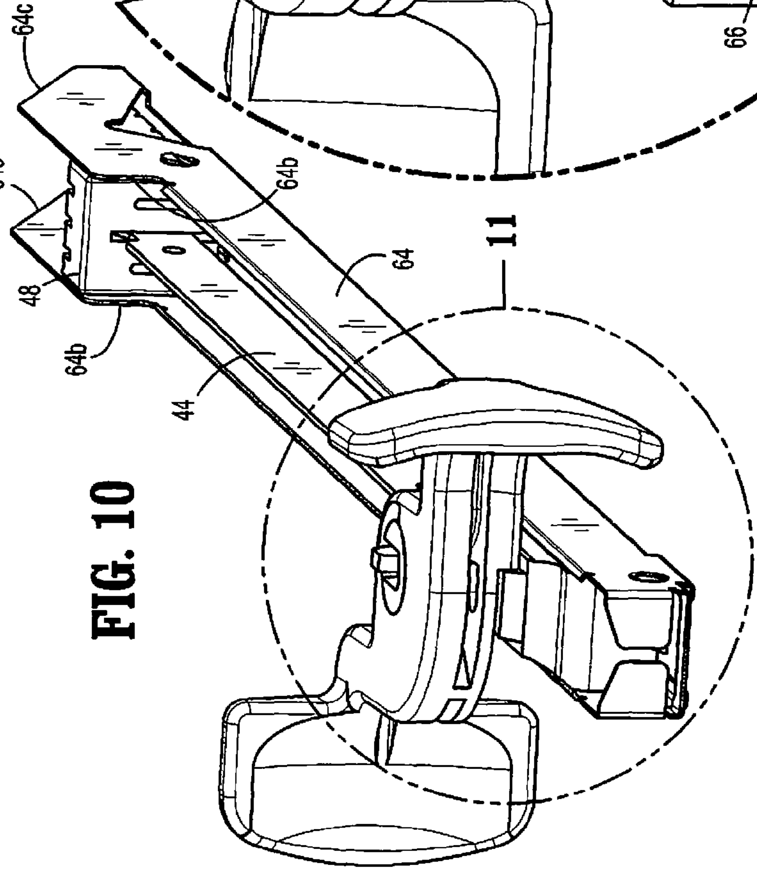



FIG. 10

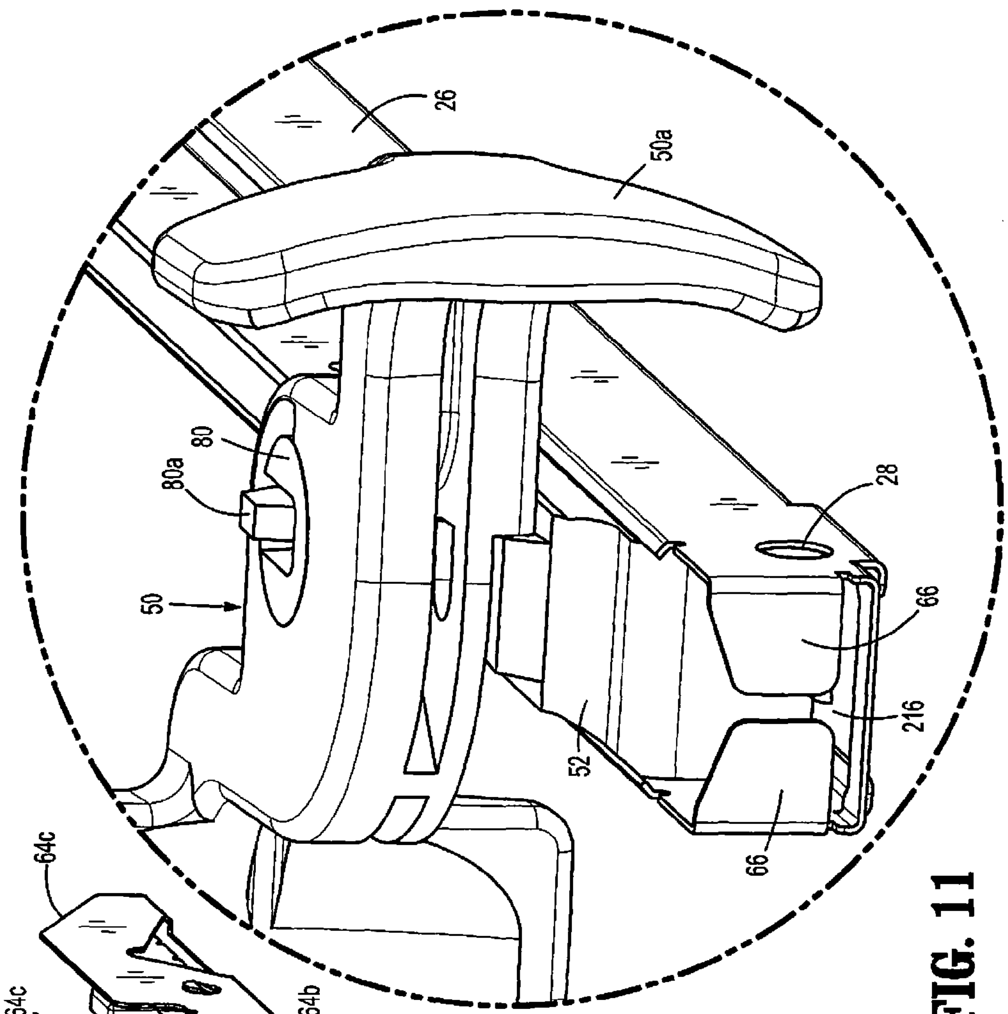
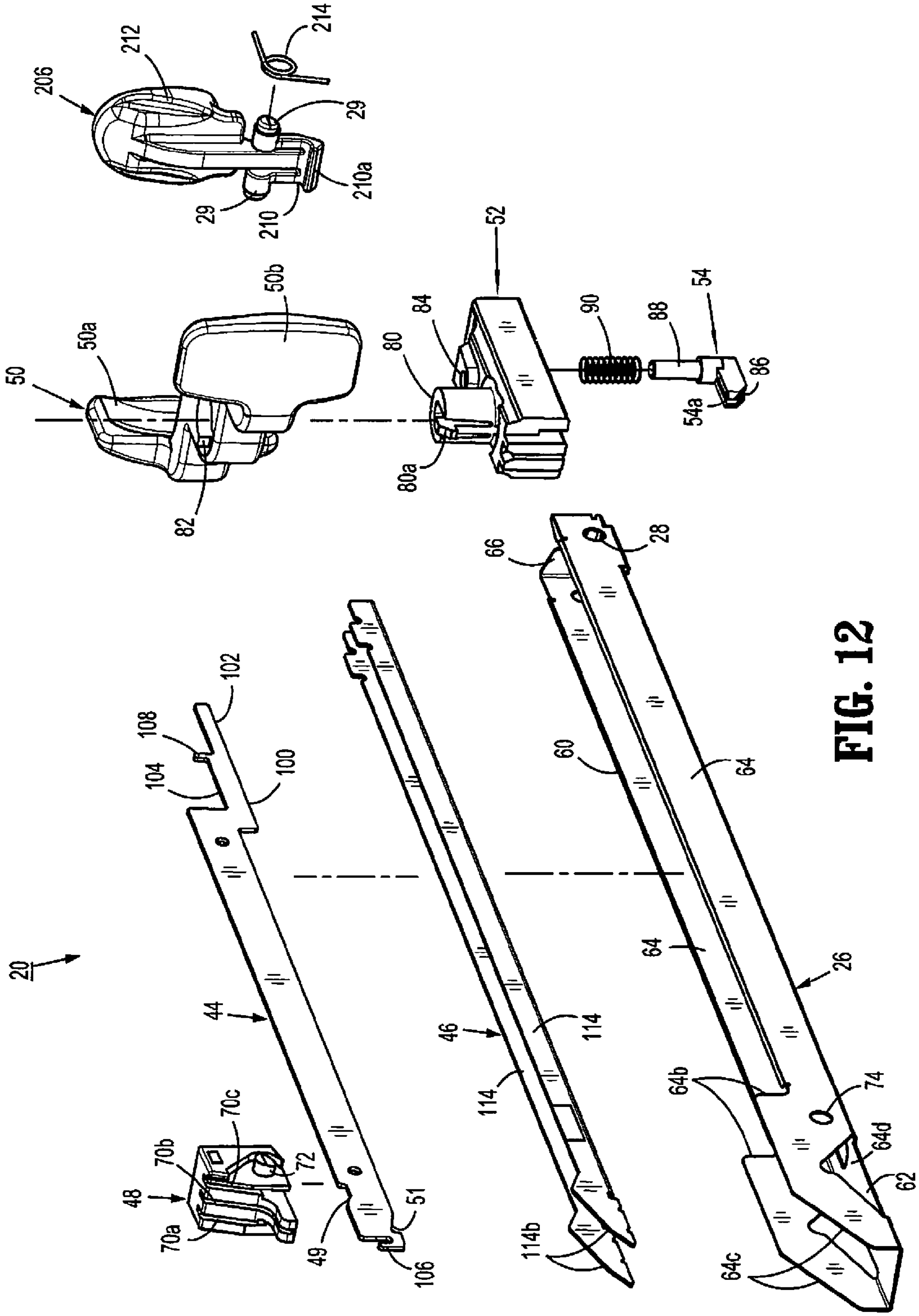



FIG. 11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54a
102
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104
100
44
48
70a
70b
70c
72
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114b
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26
64b
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64d
62
64c

FIG. 12

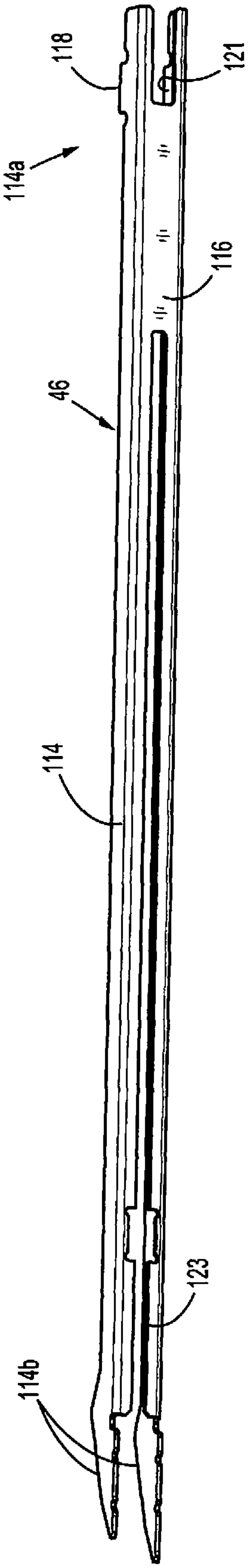


FIG. 12A

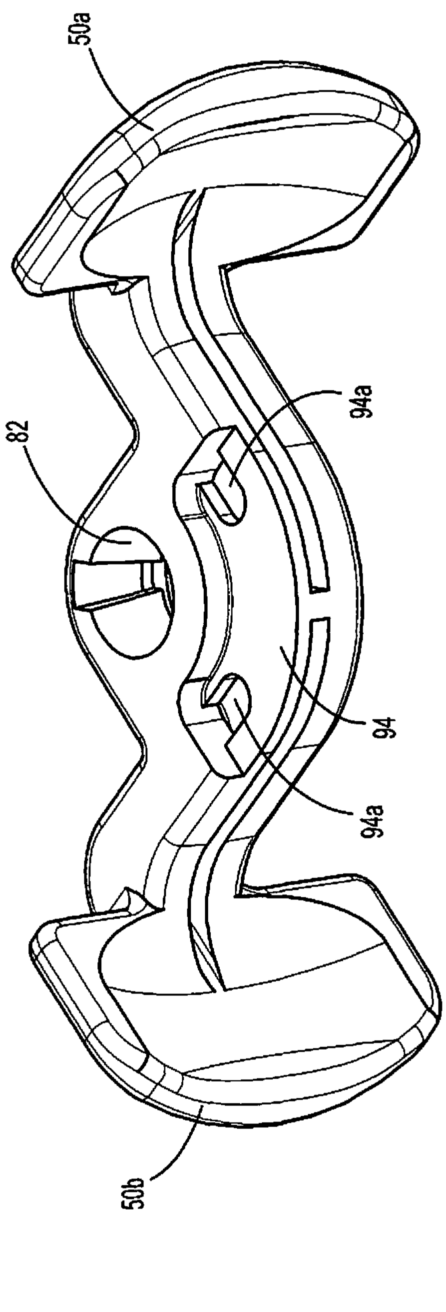


FIG. 12B

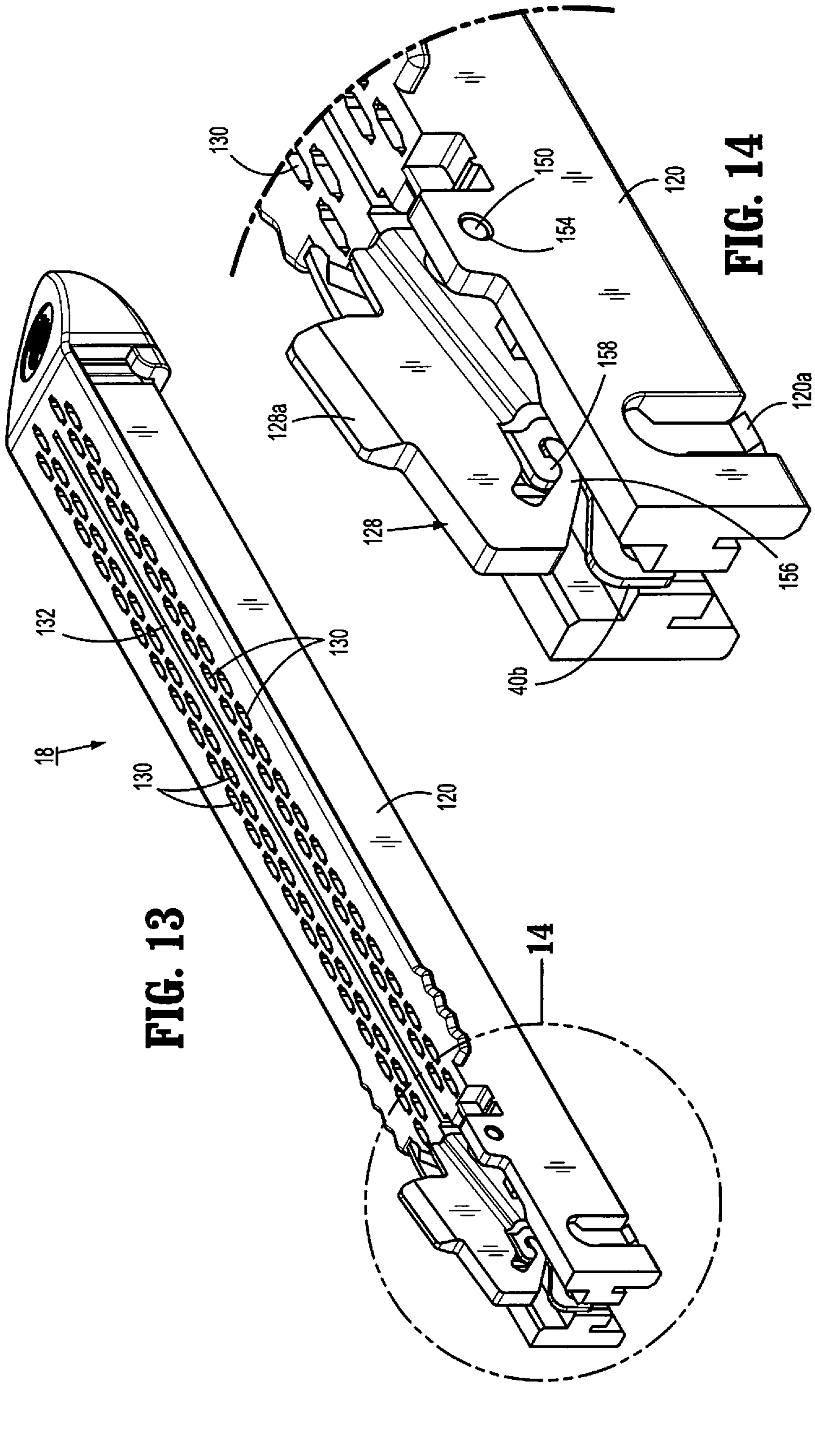


FIG. 14

FIG. 13

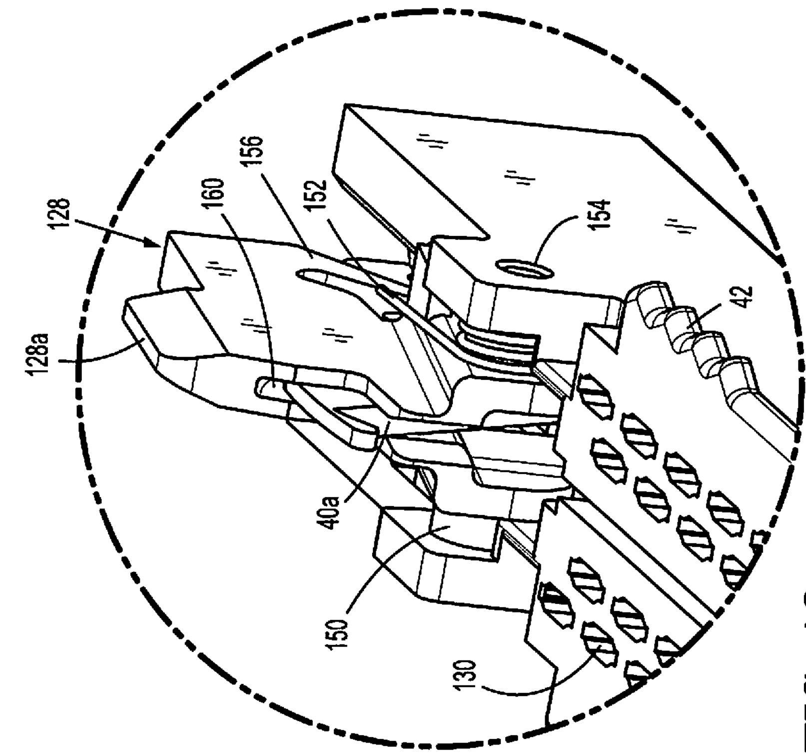


FIG. 16

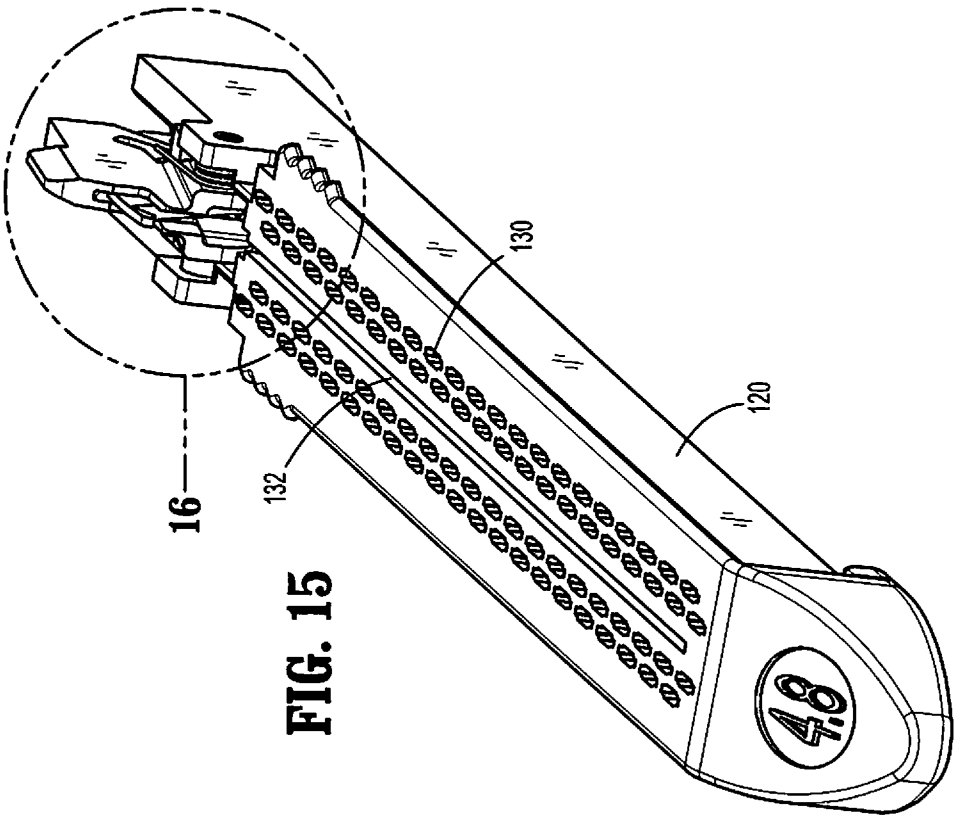


FIG. 15

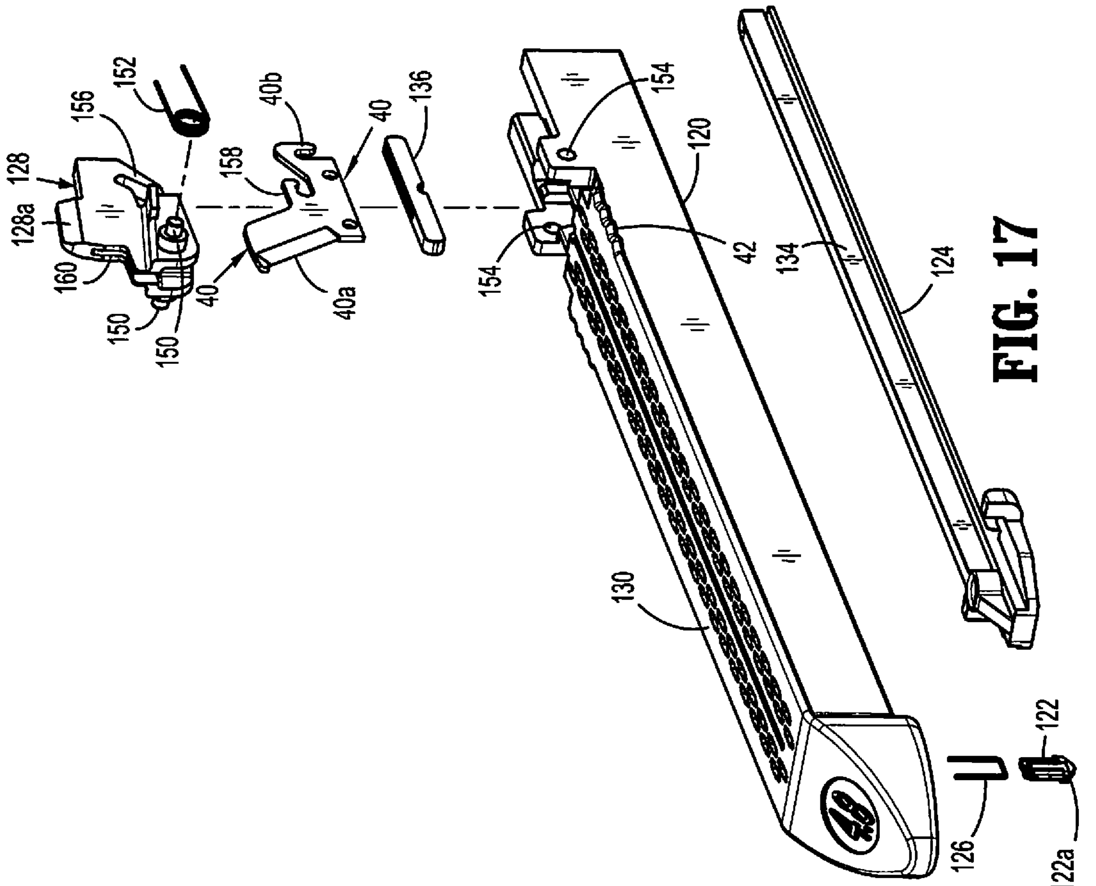
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FIG. 17

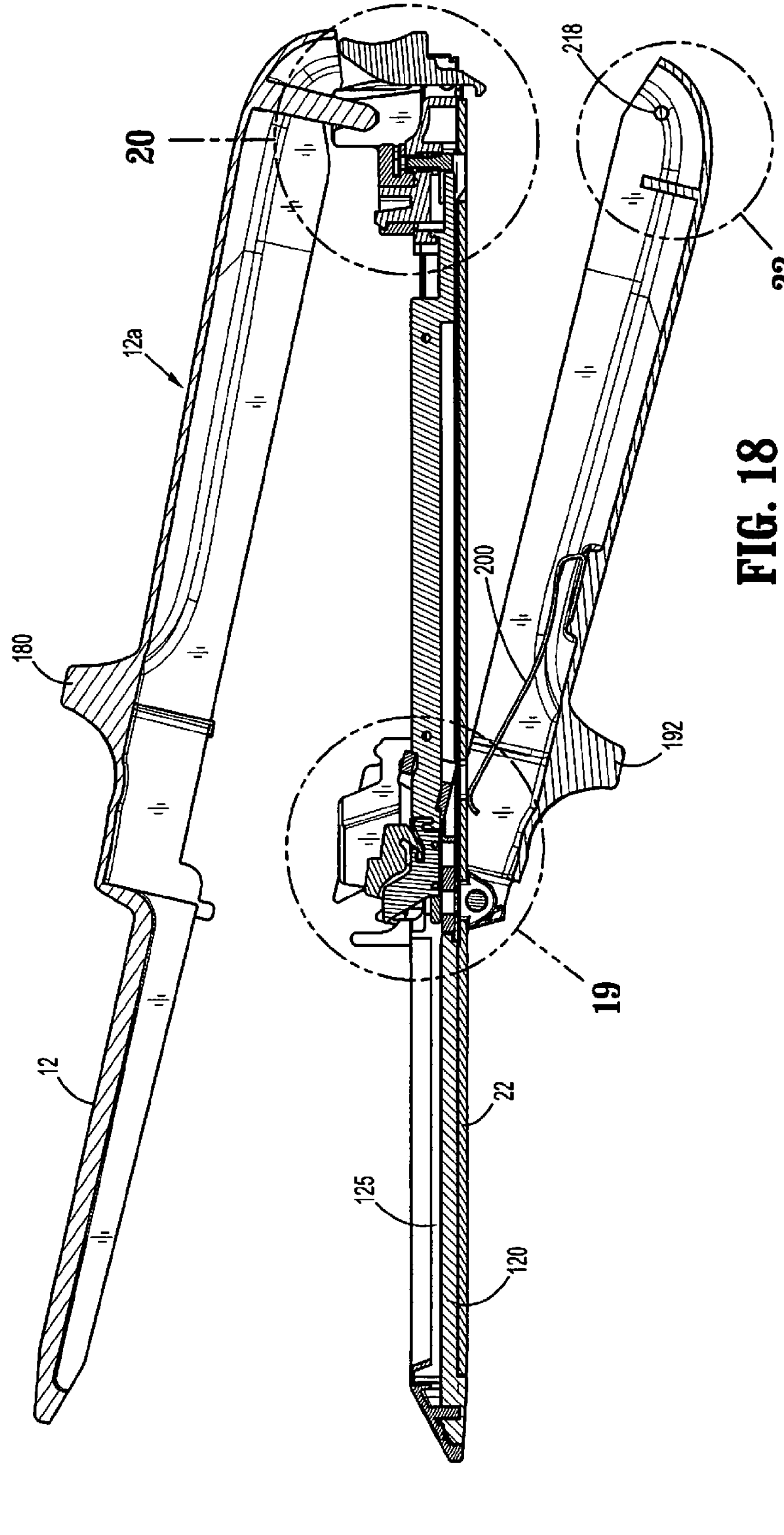


FIG. 18

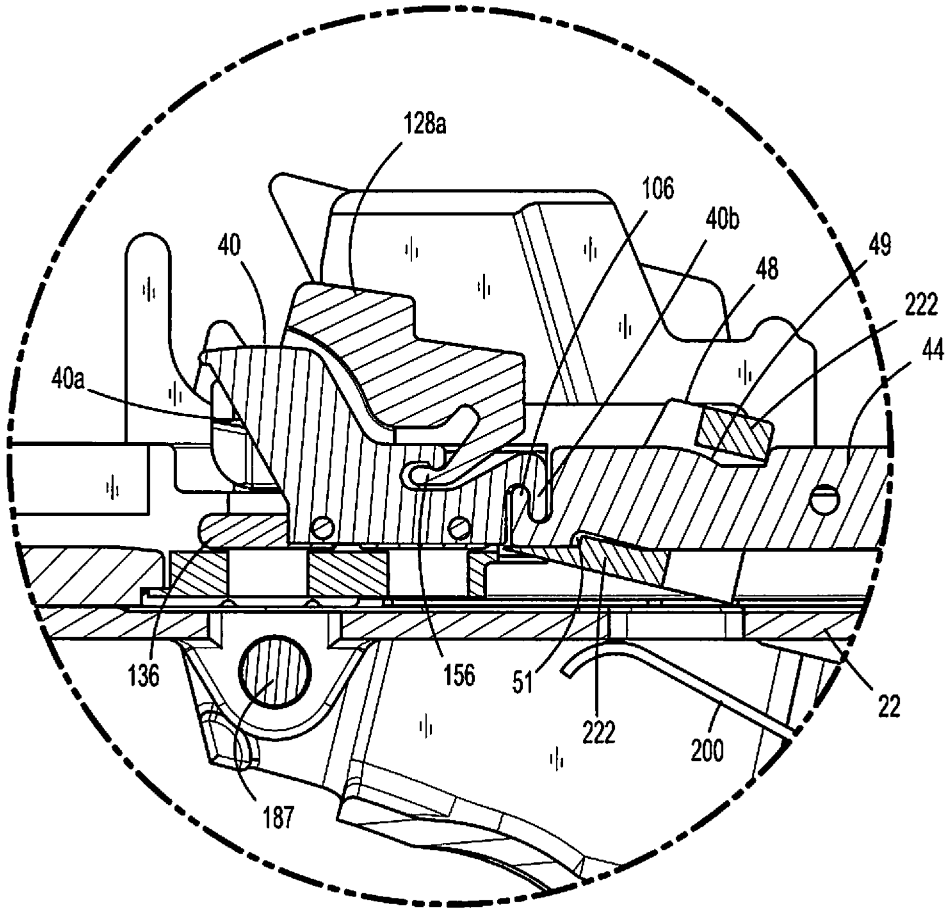


FIG. 19

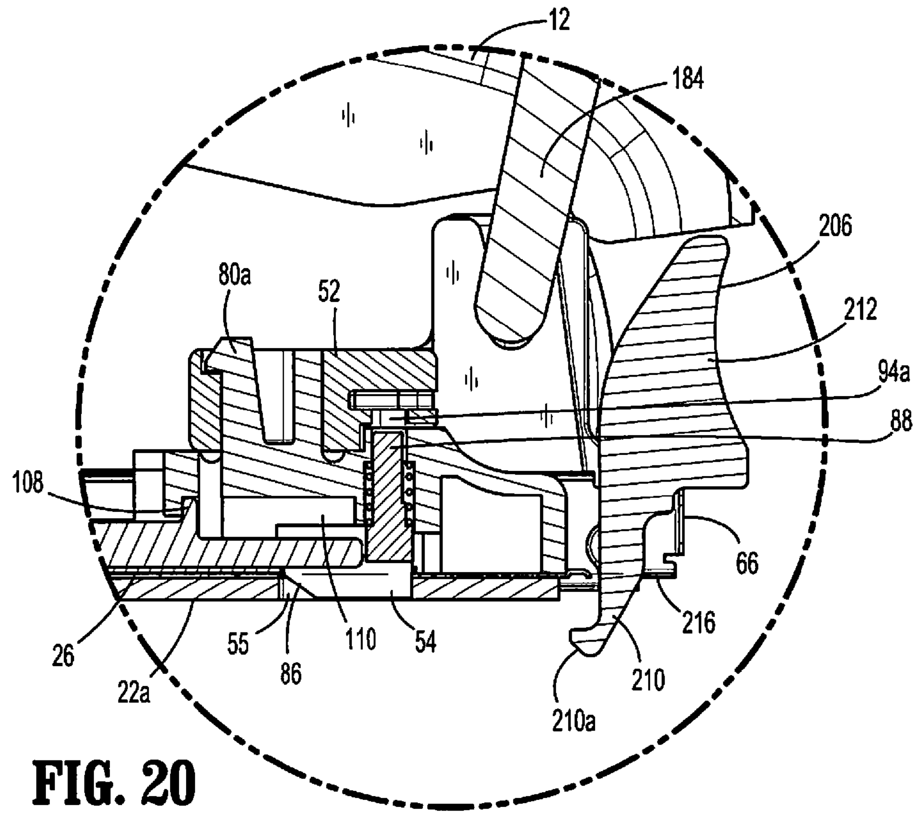
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FIG. 20

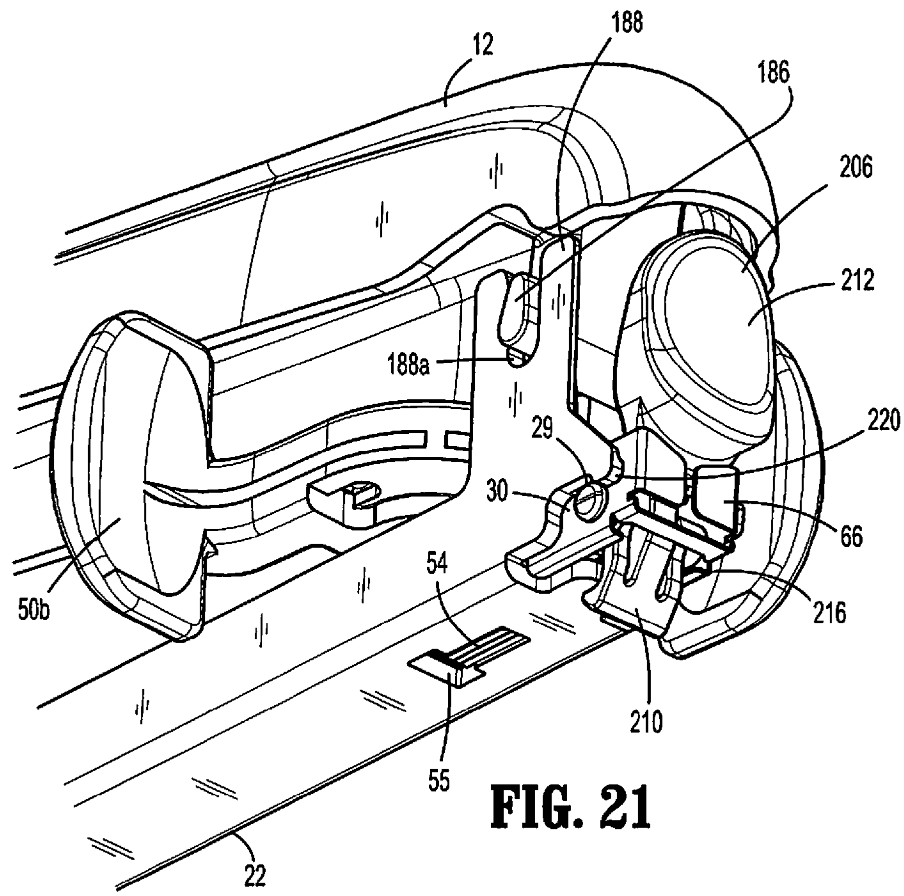
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FIG. 21

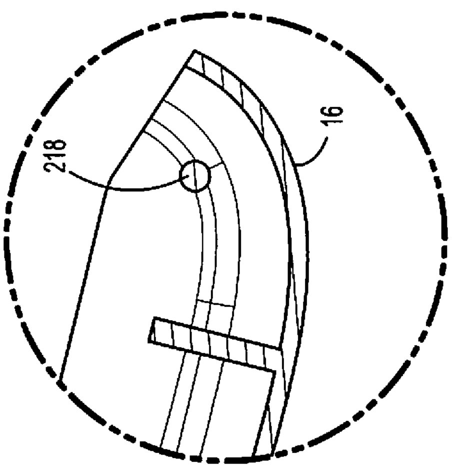


FIG. 22

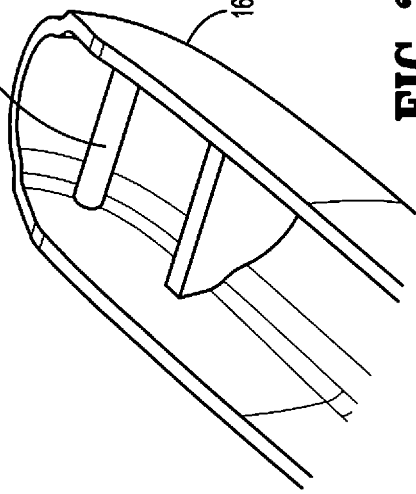


FIG. 23

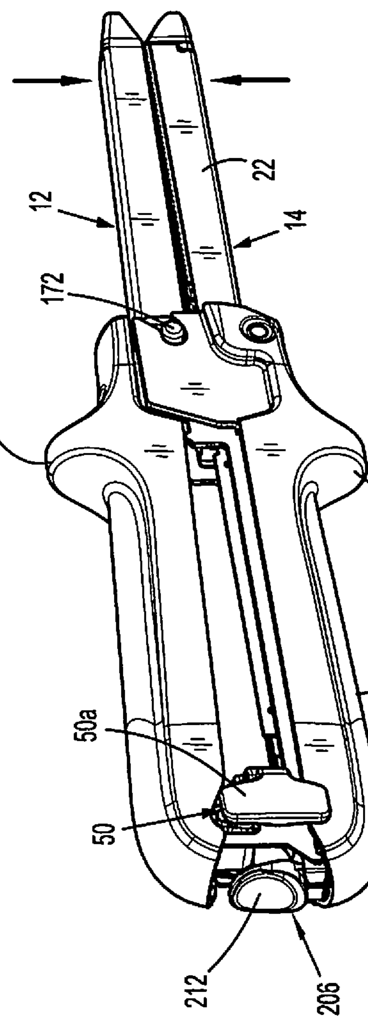


FIG. 24

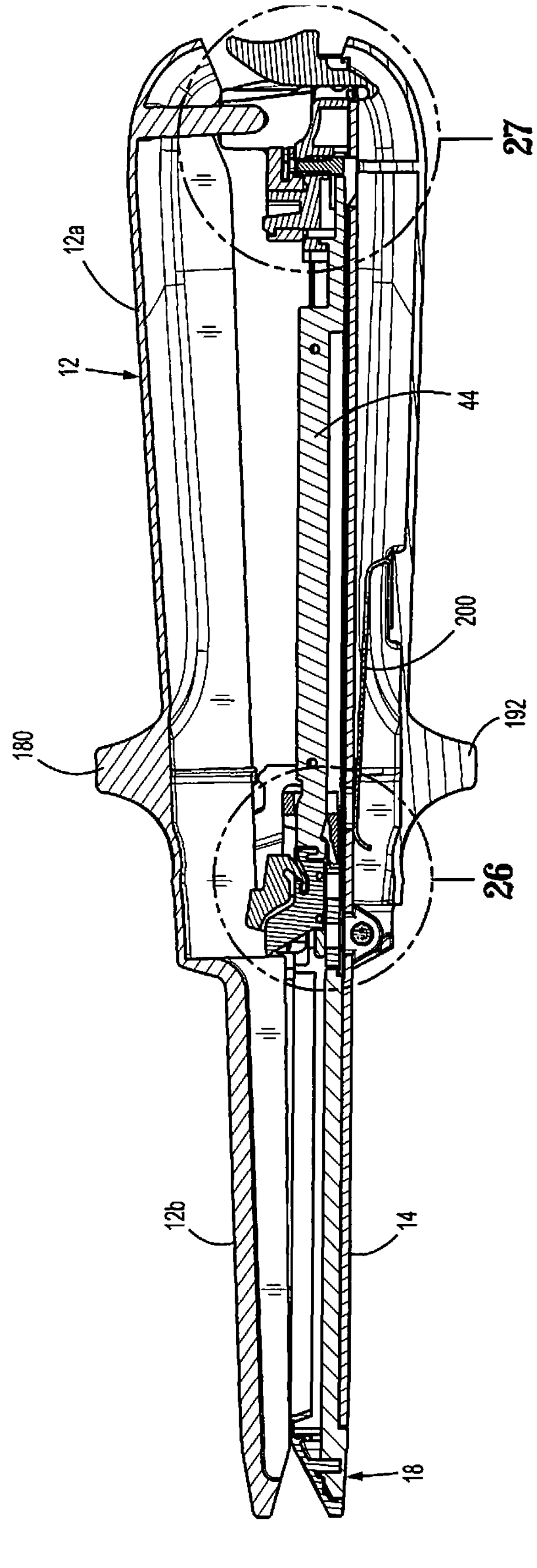


FIG. 25

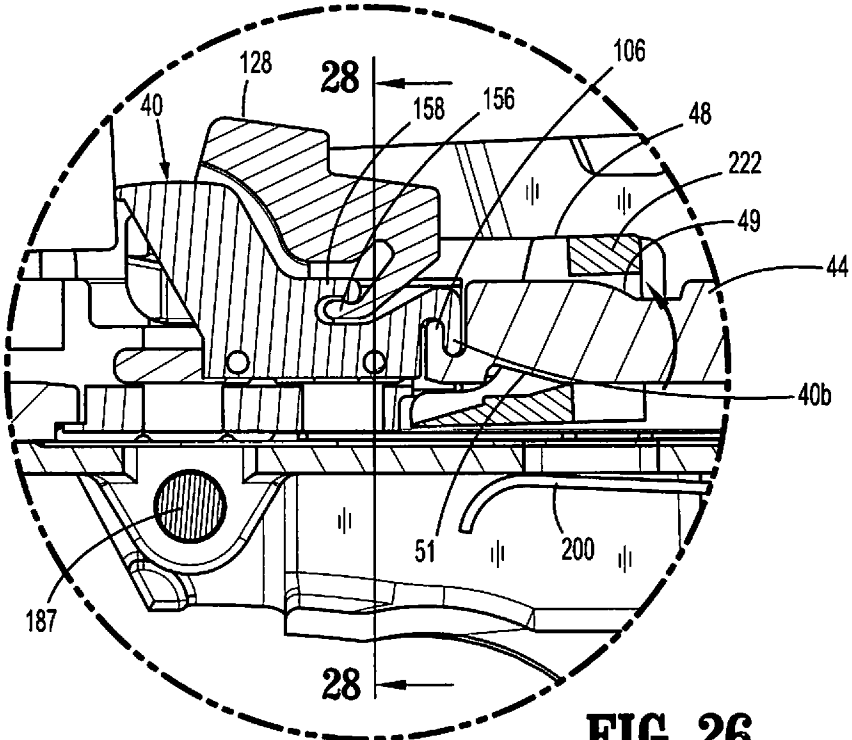
128
28
158
156
106
40
48
222
49
44
40b
51
200
187
28

FIG. 26

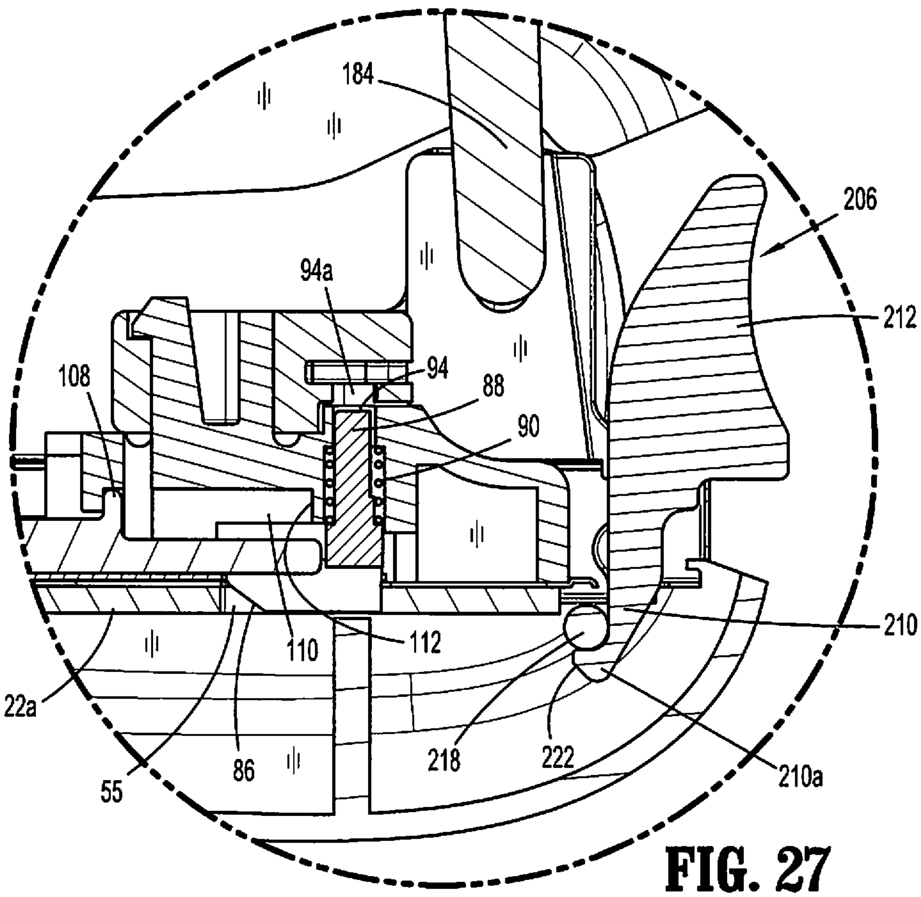
184
206
212
94a
94
108
88
90
210
112
110
22a
86
218
222
210a
55

FIG. 27

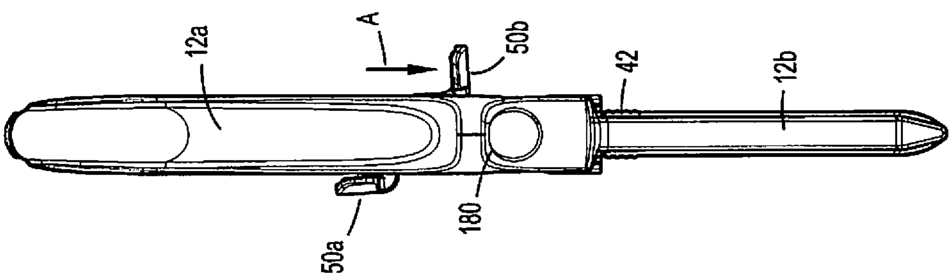


FIG. 29

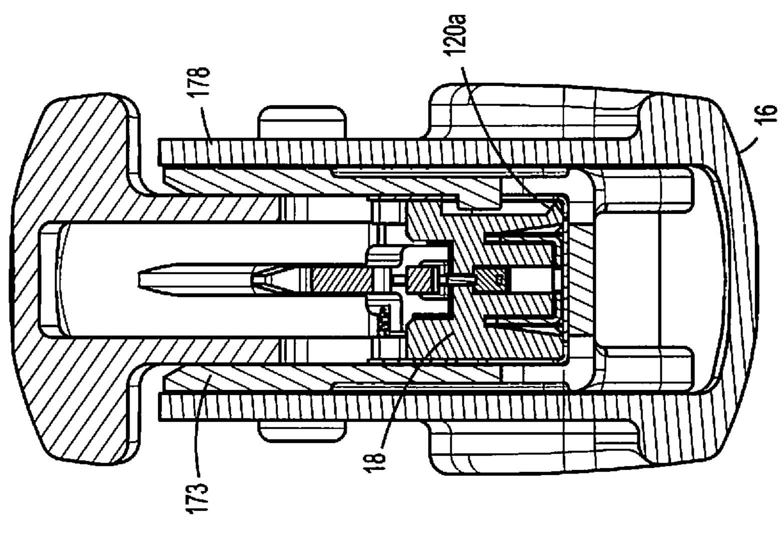


FIG. 28

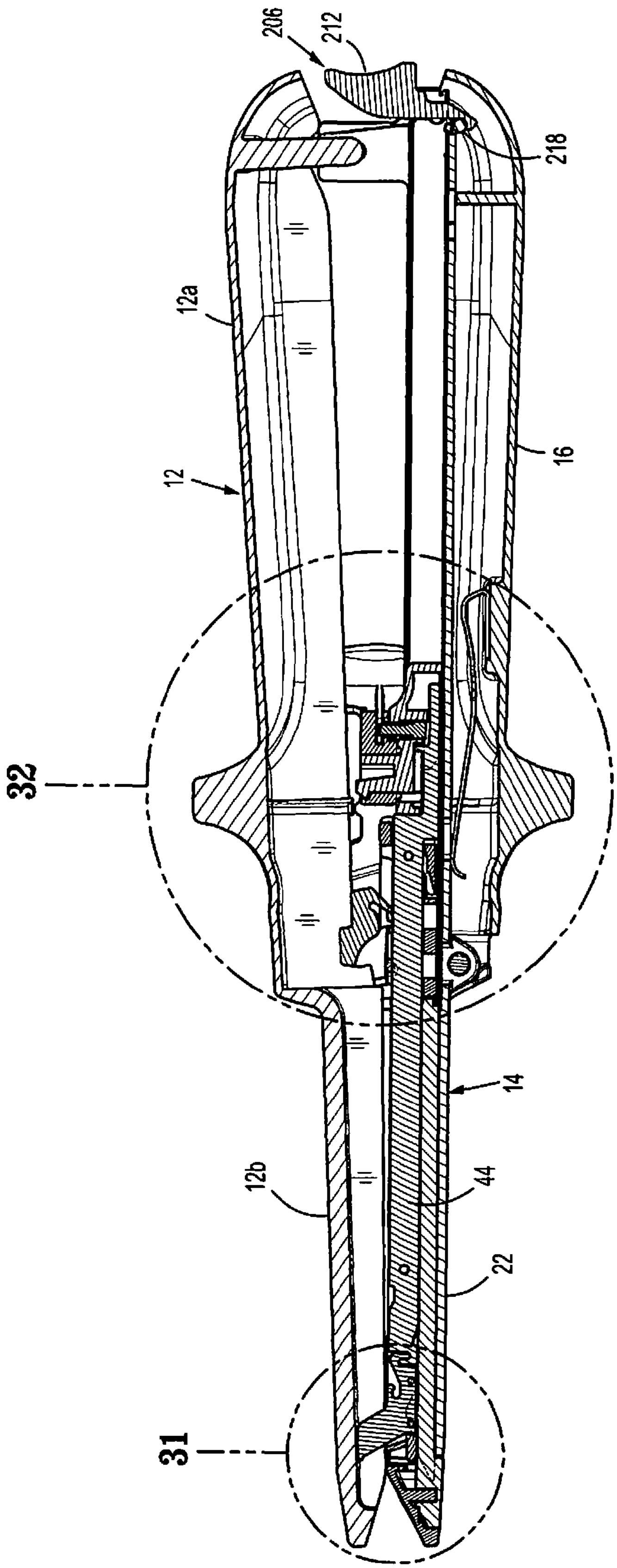


FIG. 30

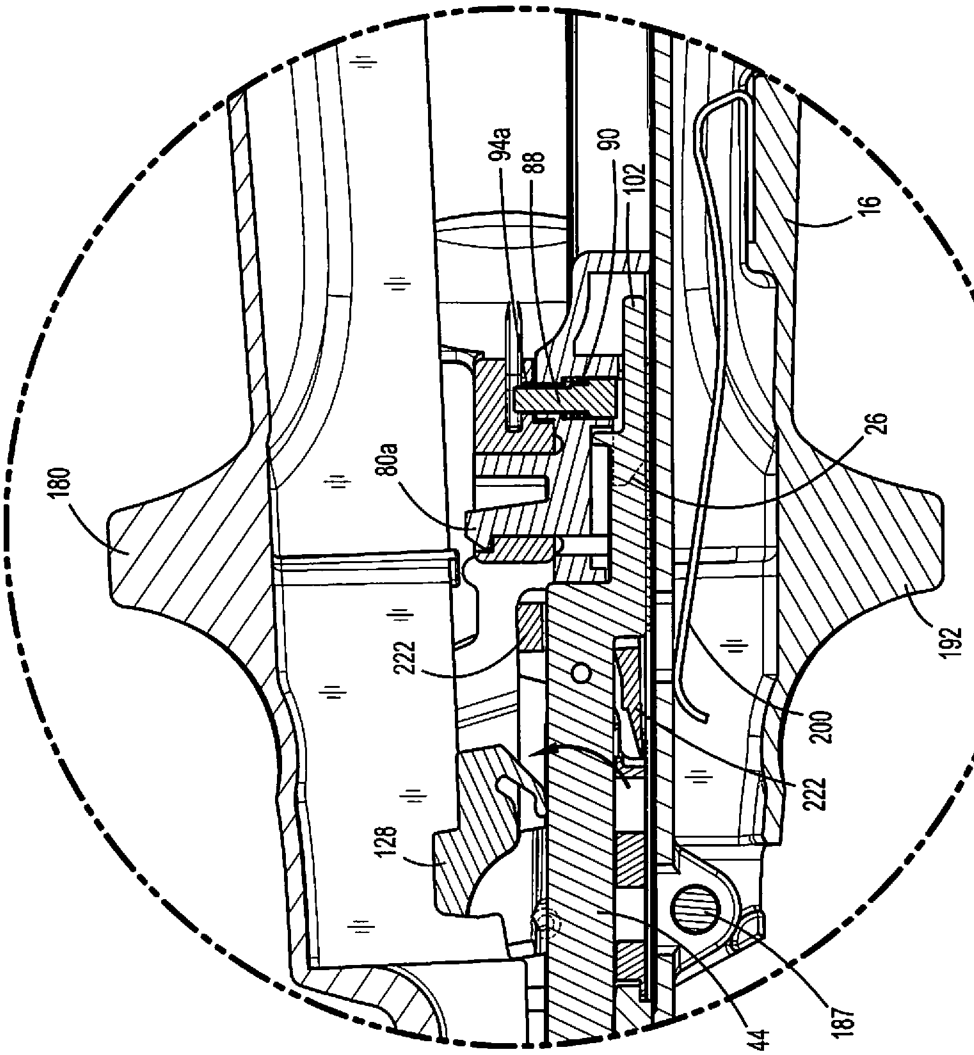
180
94a
88
90
102
16
80a
26
222
192
200
222
128
44
187

FIG. 32

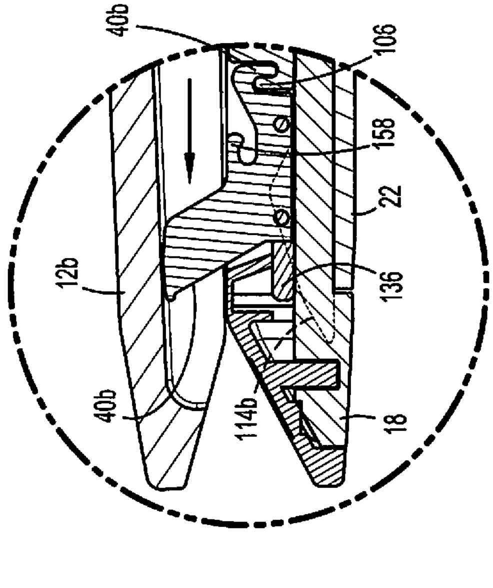
40b
106
158
22
12b
136
40b
114b
18

FIG. 31

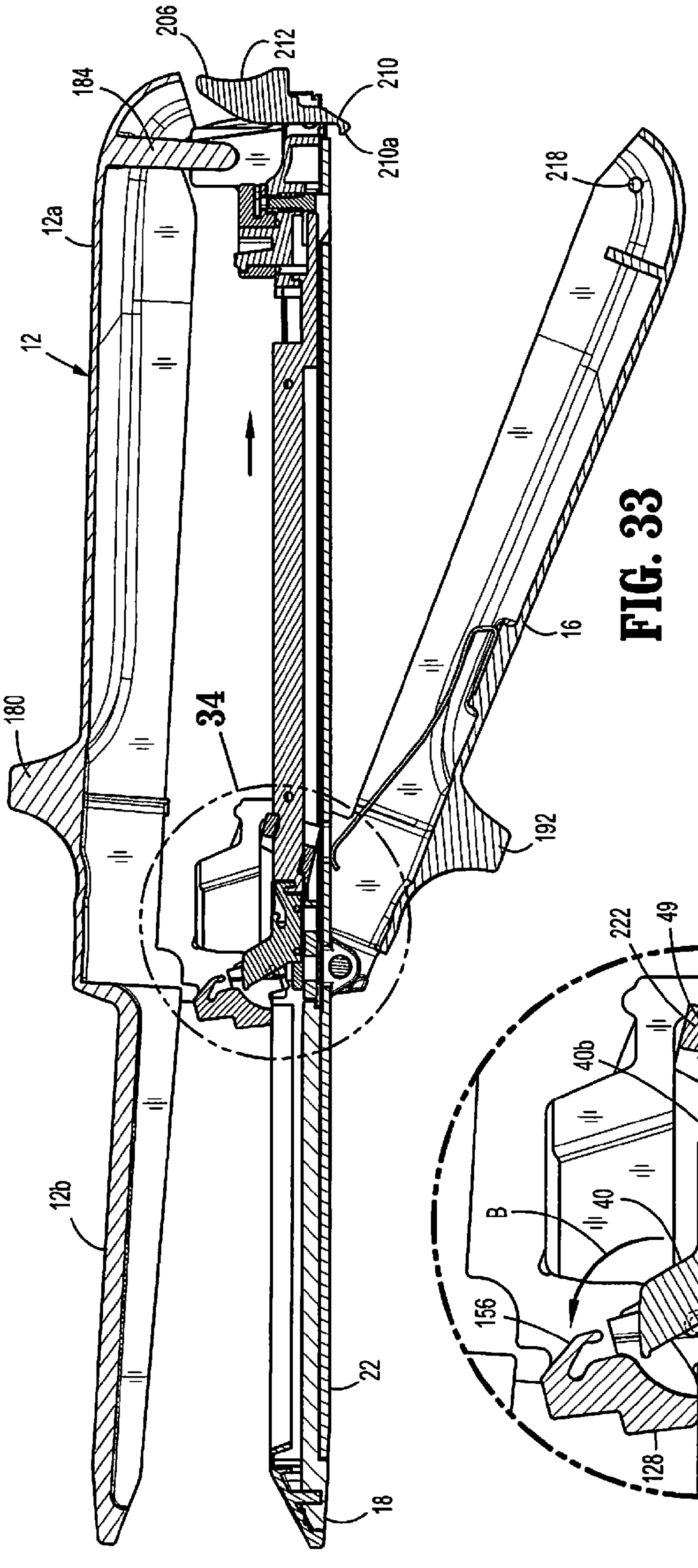
206
212
210
210a
184
12a
12
218
180
34
16
192
12b
22
18

FIG. 33

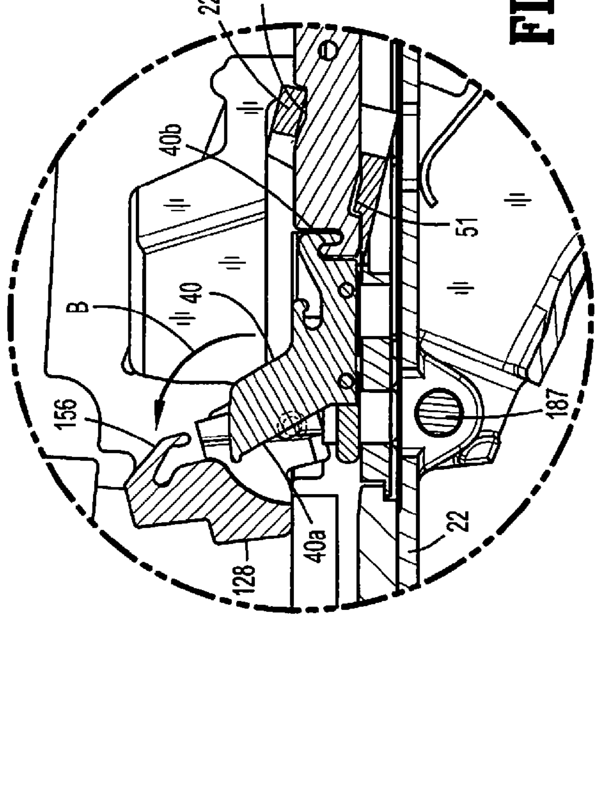
222
49
40b
51
B
40
156
187
128
40a
22

FIG. 34

# SURGICAL FASTENER APPLYING APPARATUS

This application claims priority from provisional application Ser. No. 61/494,985, filed Jun. 9, 2011, the entire contents of which are incorporated herein by reference.

## BACKGROUND

1. Technical Field

The present disclosure relates to a surgical fastener applying apparatus and, more particularly, to a surgical fastener applying apparatus having reusable and disposable components.

2. Discussion of Related Art

Surgical fastener applying apparatus, wherein tissue is first grasped or clamped between opposing jaw structures and then joined by means of surgical fasteners, are well known in the art. In some such apparatus, a knife is provided to cut the tissue which has been joined by the fasteners. The fasteners are typically in the form of surgical staples, although, other surgical fasteners may also be utilized, such as, for example, clips or two part polymeric surgical fasteners.

Surgical fastener applying apparatus typically include two elongated beam members which are used to capture or clamp tissue therebetween. Typically, one of the beam members carries a disposable cartridge assembly which houses a plurality of staples arranged in at least two lateral rows, while the other beam member includes an anvil which defines a surface for forming the staple legs as the staples are driven from the cartridge assembly. Where two part fasteners are used, the beam member which includes the anvil carries a mating part of the two part fastener, e.g. the receiver. Generally, the staple formation process is affected by the interaction between one or more longitudinally moving camming members and a series of individual staple pushers. As the camming members travel longitudinally through the cartridge carrying beam member, the individual pusher members are biased upwardly into a backspan of the staples supported within the cartridge assembly to sequentially eject the staples from the cartridge. A knife may be provided to travel with the camming members between the staple rows to cut the tissue between the rows of formed staples. An example of such an instrument is disclosed in U.S. Pat. No. 7,631,794, which is incorporated herein in its entirety by reference.

Because of the dangers associated with improper sterilization, surgical fastener applying apparatus are typically disposable after use. Although the cartridge assembly may be replaced to perform multiple fastener applying operations on a single patient, the fastener applying apparatus is typically disposable after a surgical procedure has been completed. This requirement of disposability may increase the costs associated with surgical procedures. Although reusable fastener applying apparatus have been developed, such apparatus can be overly complex and prove difficult to sterilize.

A need exists in the art for a fastener applying apparatus which includes reusable components, is not overly complex and is configured to facilitate proper sterilization after use in a surgical procedure.

## SUMMARY

The present invention relates to a surgical fastener applying apparatus for applying surgical fasteners to tissue. In one embodiment, the apparatus includes an anvil half-section including a distal anvil portion and a proximal handle portion. A cartridge receiving half-section defines an elongated channel member having a distal portion dimensioned to releasably receive a single use loading unit and a proximal portion configured to support a firing assembly. A clamping lever is secured to the cartridge receiving half-section and includes a proximal portion and a distal portion and a handle portion supporting an engagement member. A firing assembly is configured to be releasably supported within the proximal portion of the cartridge receiving half-section. The firing assembly includes a stationary housing, a firing lever, a cam bar fixedly secured to the firing lever, and a pivotal locking member including a latch portion. The clamping lever is operably associated with the anvil half-section and the cartridge receiving half-section and is movable from an unclamped position to a clamped position to releasably secure the anvil portion of the anvil half-section in close approximation with the single use loading unit. In the clamped position, the engagement member of the clamping lever releasably engages the latch portion of the locking member to releasably retain the clamping lever in the clamped position.

In one embodiment, the engagement member includes a cylindrical post, although other engagement member configurations are also envisioned. The latch portion, in one embodiment, includes a hook member engageable with the engagement member of the clamping lever. The locking member can include a pair of pivot members which are pivotally supported in openings defined in a proximal end of the stationary housing of the firing assembly. A spring member can be supported on the clamping lever and positioned to engage the cartridge receiving half-section to urge the clamping lever to the unclamped position. A biasing member can be provided to urge the latch portion inwardly towards the stationary housing.

In one embodiment, a finger engagement member is positioned on the locking member wherein the finger engagement member is depressed to release the latch portion from the engagement member of the clamping lever. The finger engagement member can be positioned proximal of the firing lever. In one embodiment, the finger engagement member is positioned on one end of the locking member and the latch portion is positioned on the other end of the locking member.

In one embodiment, the latch portion extends through an opening in the proximal end of the stationary housing and below a bottom surface of the elongate channel member.

In one embodiment, the firing assembly and single use loading unit are disposable and the anvil half-section, cartridge receiving half-section and clamping lever are reusable.

In one embodiment, the elongated channel member has first and second cutouts to receive the pivot members to releasably secure the firing assembly within the proximal portion of the channel member.

The stationary housing can include a U-shaped frame including a bottom wall and a pair of sidewalls, wherein each of the sidewalls has a proximal end defining the openings and the pivot members are dimensioned to extend through the openings at a position to be received in cutouts formed in a proximal end of the cartridge receiving half-section to releasably retain the stationary housing within the proximal portion of the elongated channel member.

The firing assembly can include a guide block axially fixed within the U-shaped frame and a slide block slidably positioned with the U-shaped frame, wherein the firing lever is pivotally secured to the slide block and the cam bar is fixedly secured to the slide block such that the slide block is slidable through the U-shaped frame to advance the cam bar through the distal portion of the elongated channel member. The firing assembly can further include a knife actuating bar which is configured to engage a knife supported within the single use loading unit.

The cartridge receiving half-section can include a sidewall defining a depression and the clamping lever can include a sidewall defining a protrusion wherein the protrusion is positionable within the depression to retain the clamping lever.

In one embodiment, the clamping lever is releasably secured to the cartridge receiving half-section.

BRIEF DESCRIPTION OF THE DRAWINGS

Various embodiments of the presently disclosed surgical fastener applying apparatus will now be described herein with reference to the accompanying figures wherein:

FIG. **1** is a side perspective view from the distal end of one embodiment of the presently disclosed surgical fastener applying apparatus in the clamped position;

FIG. **2** is a side perspective view from the proximal end of the surgical fastener applying apparatus shown in FIG. **1** in the clamped position;

FIG. **2**A is a side perspective view of the surgical fastener applying apparatus shown in FIG. **1** in the open position;

FIG. **2**B is an enlarged view of the indicated area of detail shown in FIG. **2**A;

FIG. **3** is a side perspective view with parts separated of the surgical fastener applying apparatus shown in FIG. **1**;

FIG. **3**A is a side cross-sectional view of the clamp lever of the fastener applying apparatus shown in FIG. **1**;

FIG. **4** is a side perspective view of the cartridge receiving half-section of the surgical fastener applying apparatus shown in FIG. **1** with the single use loading unit and the firing assembly supported therein;

FIG. **5** is an enlarged view of the indicated area of detail shown in FIG. **4**;

FIG. **6** is a perspective view from above of the cartridge receiving half-section of the surgical fastener applying apparatus with the SULU and the firing assembly supported therein;

FIG. **7** is an enlarged view of the indicated area of detail shown in FIG. **6**;

FIG. **8** is a front end perspective view from above of the firing assembly of the surgical fastener applying apparatus shown in FIG. **3**;

FIG. **9** is an enlarged view of the indicated area of detail shown in FIG. **8**;

FIG. **9**A is a top perspective view of the channel member with the firing assembly releasably secured therein;

FIG. **9**B is an enlarged view of the indicated area of detail shown in FIG. **9**A;

FIG. **9**C is a top perspective view of a central portion of the channel member;

FIG. **10** is a rear end perspective view from above of the firing assembly shown in FIG. **8**;

FIG. **11** is an enlarged view of the indicated area of detail shown in FIG. **10**;

FIG. **12** is a side perspective view of the firing assembly shown in FIG. **10** with parts separated;

FIG. **12**A is a bottom perspective view of the cam bar of the firing assembly shown in FIG. **12**;

FIG. **12**B is a bottom perspective view of the firing lever of the firing assembly shown in FIG. **12**;

FIG. **13** is a side perspective view of the SULU of the surgical fastener applying apparatus shown in FIG. **1**;

FIG. **14** is an enlarged view of the indicated area of detail shown in FIG. **13**;

FIG. **15** is a front perspective view of the SULU shown in FIG. **13**;

FIG. **16** is an enlarged view of the indicated area of detail shown in FIG. **15**;

FIG. **17** is a side perspective view with parts separated of the SULU shown in FIG. **15**;

FIG. **18** is a side cross-sectional view of the surgical fastener applying apparatus shown in FIG. **1** in the open position;

FIG. **19** is an enlarged view of the indicated area of detail shown in FIG. **18**;

FIG. **20** is an enlarged view of the indicated area of detail shown in FIG. **18**;

FIG. **21** is a perspective view of the proximal end of the surgical fastener applying apparatus shown in FIG. **18** in the open position;

FIG. **22** is an enlarged view of the indicated area of detail shown in FIG. **18**;

FIG. **23** is a perspective view from below of the proximal end of the clamping lever of the surgical fastener applying apparatus shown in FIG. **1**;

FIG. **24** is a side perspective view of the surgical fastener applying apparatus shown in FIG. **1** in the clamped position;

FIG. **25** is a side cross-sectional view of the surgical fastener applying apparatus shown in FIG. **24** in the clamped position;

FIG. **26** is an enlarged view of the indicated area of detail shown in FIG. **25**;

FIG. **27** is an enlarged view of the indicated area of detail shown in FIG. **25**;

FIG. **28** is a cross-sectional view taken along section lines **28-28** of FIG. **26**;

FIG. **29** is a top view of the surgical fastener applying apparatus shown in FIG. **1** as the firing assembly is moved through an actuating stroke to eject fasteners from the fastener applying apparatus;

FIG. **30** is a side cross-sectional view of the surgical fastener applying apparatus shown in FIG. **29** with the firing assembly in the actuated position;

FIG. **31** is an enlarged view of the indicated area of detail shown in FIG. **30**;

FIG. **32** is an enlarged view of the indicated are of detail shown in FIG. **30**;

FIG. **33** is a side cross-sectional view of the surgical fastener applying apparatus shown in FIG. **1** after the apparatus has been fired and moved to the open position; and

FIG. **34** is an enlarged view of the indicated area of detail shown in FIG. **33**.

DETAILED DESCRIPTION OF EMBODIMENTS

Embodiments of the presently disclosed surgical fastener applying apparatus in accordance with the present disclosure will now be described in detail with reference to the drawings wherein like reference numerals identify similar or identical structural elements. As used herein, as is traditional, the term "proximal" refers to the end of the apparatus which is closer to the user and the term distal refers to the end of the apparatus which is further away from the user.

FIGS. **1-34** illustrate one embodiment of the presently disclosed surgical fastener applying apparatus designated generally as surgical stapler **10**. Referring specifically to FIGS. **1-3**, surgical stapler **10** includes an anvil half-section **12**, a cartridge receiving (supporting) half-section **14**, a clamping lever **16**, a single use loading unit or cartridge **18** (hereinafter "SULU") and a firing assembly **20**. In one embodiment, anvil half-section **12**, cartridge receiving half-section **14** and clamping lever **16** are constructed to be reusable components and, as such, are constructed from a biocompatible material suitable for sterilization and repeated use, e.g., stainless steel. In contrast, SULU **18** and firing assembly **20** are constructed to be disposable and, as such, may be constructed from any suitable biocompatible material, e.g., plastics, metals, combinations thereof, having the requisite strength characteristics. SULU **18** and firing assembly **20** can alternatively be constructed as an integral unit to be loaded as a single unit into the cartridge receiving half-section **18**.

Referring to FIGS. **3-7**, cartridge receiving half-section **14** defines an elongated channel member **22** which defines a substantially U-shaped channel **24** having a distal portion **24***a* dimensioned to releasably receive a SULU **18** and a proximal portion **24***b* dimensioned to releasably receive firing assembly **20**. Firing assembly **20** includes a stationary housing **26** (see also FIG. **12**) having a proximal end including openings **28** which receive ends of pivot members **29**. Pivot members **29** pivotally support a locking member **206** on a proximal end of stationary housing **26** and extend through openings **28** into recesses **30** (FIG. **3**) formed in a proximal portion of cartridge receiving half-section **14** to releasably secure the proximal end of firing assembly **20** within the proximal portion **24***b* of channel member **22** as will be discussed in further detail below. The distal end of firing assembly **20** defines a triangular cutout **64***d*. Cutout **64***d* is positioned to receive a protrusion **65** formed on an inner wall of channel member **22** (see FIGS. **9**A-9C) to releasably secure the distal end of firing assembly **20** within channel member **22**. The structure of firing assembly **20** will also be discussed in further detail below. SULU **18** includes a pair of distal protrusions **32** which are positioned in cutouts **34** formed at the distal end of channel member **22** to releasably secure SULU **18** within the distal portion **24***a* of channel member **22**. During assembly, firing assembly **20** must be inserted into proximal portion **24***b* of channel member **22** before SULU **18** is inserted into distal portion **24***a* of channel member **22** as will be discussed below. To position SULU **18** in channel member **22**, protrusions **32** on SULU **18** are positioned within cutouts **34** while SULU **18** is positioned above and at an angle to channel member **22**. Thereafter, SULU **18** can be rotated downwardly into distal portion **24***a* of U-shaped channel **24**. This allows for the drive components of firing assembly **20** to properly align with components of SULU **18** and also facilitates engagement of the firing assembly **20** with a knife **40** (FIG. **17**) supported within SULU **18**. A proximal end of SULU **18** includes an outwardly extending serrated surface **42** (FIG. **7**) to facilitate gripping of the proximal end of SULU **18** to allow for removal and/or replacement of SULU **18** from channel member **22**. Prior to movement of stapler **10** to the clamped position, as will be discussed below, serrated gripping surface **42** will not fully seat within distal portion **24***a* of channel member **22**.

Referring to FIGS. **8-12**, firing assembly **20** includes stationary housing **26**, a knife actuating bar **44**, a cam bar **46**, a guide block **48**, a firing lever **50**, a slide block **52**, a pedal **54** and pivotal locking member **206** (FIG. **12**). In one embodiment, stationary housing **26** includes a U-shaped frame **60** including a bottom wall **62** and a pair of sidewalls **64**. The distal end of each sidewall **64** defines a proximal step **64***b*, a distal angled portion **64***c* and the triangular cutout **64***d*. As discussed above, triangular cutout **64***d* is positioned to receive the protrusion **65** (FIG. 9B) formed on an inner wall of channel member **22**. A proximal end of each sidewall **64** includes a pair of transversely extending deformable wall portions **66** (FIG. **11**) which are spaced from a proximal end of slide block **52** and define an area between wall portions **66** and slide block **52** for pivotally receiving locking member **206** as will be discussed in further detail below.

Guide block **48** includes a body defining three longitudinal slots **70***a-c* and a pair of outwardly extending protrusions **72**. In one embodiment, each protrusion **72** is substantially cylindrical and includes a tapered portion **72***a* (FIG. **9**). Alternately, other protrusion configurations are envisioned. Protrusions **72** are dimensioned to be received in openings **74** (FIG. **12**) formed in sidewalls **64** of stationary housing **26** to axially fix guide block **48** within the distal end of stationary housing **26**. Protrusions **72** allow for a degree of pivotal movement of guide block **48** within U-shaped frame **60**. As will be discussed in further detail below, guide block **48** is pivotal from a first position (FIG. **19**) in locking engagement with notches **49** and **51** of knife actuating bar **44** to a second position (FIG. **26**) disengaged from notches **49** and **51** of knife actuating bar **44** in response to movement of stapler **10** to the clamped position. A torsion spring is provided about protrusion **72** to urge guide block **48** into locking engagement with notches **49** and **51**. Each of slots **70***a* and **70***c* is dimensioned to slidably receive a respective sidewall **114** of cam bar **46**. Similarly, slot **70***b* is dimensioned to slidably receive knife actuating bar **44**.

Slide block **52** includes a hub **80** which includes a resilient finger **80***a* configured to be snap-fit into a pivot hole **82** formed in firing lever **50**. Firing lever **50** is pivotal about hub **80** when the slide block **52** is in a retracted position to facilitate actuation of the firing assembly **20** from either side of stapler **10**. Pedal **54** is reciprocally received within a hole **84** formed in slide block **52**. Pedal **54** includes a split body portion **54***a* which is configured to straddle a proximal end **102** of knife actuating bar **44**. In one embodiment, split body portion **54***a* includes an angled distal surface **86**. A pin **88** extends upwardly from pedal **54** through hole **84** in slide block **52**. A biasing member **90** is positioned between split body portion **54***a* and slide block **52**, about pin **88** to urge pedal **54** downwardly away from slide block **52** to an extended position. In the retracted position of slide block **52**, pedal **54** is received in a cutout **55** formed in a bottom wall **22***a* of channel member **22** (FIG. **20**).

Firing lever **50** includes first and second finger engagement members **50***a* and **50***b*, either one of which can be selectively engaged to move the firing lever **50** through a firing stroke from either side of stapler **10**. An arcuate recess **94** (FIG. **12**B) is formed in a bottom surface of firing lever **50** which slidably receives pin **88** of pedal **54** to define the range of rotation through which firing lever **50** can pivot about hub **80** of slide block **52**. As used herein, a firing stroke is defined as movement of firing lever **50** from a fully retracted position (FIG. **25**) to a fully advanced position (FIG. **30**). A stop recess **94***a* is formed at each end of arcuate recess **94**. Stop recesses **94***a* are configured and dimensioned to receive the end of pin **88** of pedal **54** to prevent pivotal movement of firing lever **50** about hub **80** during a firing stroke of surgical stapler **10**. More specifically, when the firing assembly **20** is actuated to advance slide block **52** distally within stationary housing **26**, angled distal surface **86** of pedal **54** engages channel member **22** and is cammed out of cutout **55** (FIG. **27**) to urge pin **88** upwardly into a stop recess **94***a* to prevent pivotal movement of firing lever **50** during movement of firing lever **50** through a firing stroke. As is evident, pin **88** must be positioned beneath a stop recess **94***a* to allow pedal **54** to lift upwardly from cutout **55** to allow firing lever **50** to be moved through the firing stroke. Thus, firing lever **50** must be pivoted to one side or the other of firing assembly **20** before the firing lever **50** can be moved through a firing stroke.

Knife actuating bar **44** includes a proximal end having a stepped portion **100** which includes a proximal first step **102** having a first height and a second step **104** having a second height which is greater than the first height. A distal end of actuating bar **44** includes an upturned hook portion **106** and upper and lower notches **49** and **51**. A finger **108** projects upwardly from knife actuating bar **44** between first and second steps **102** and **104**. As shown in FIG. **27**, finger **108** is slidably received within a recess **110** formed in an underside of slide block **52**. When slide block **52** is advanced distally within stationary housing **26**, finger **108** moves within recess **110** such that slide block **52** moves in relation to knife actuating bar **44** until finger **108** engages a wall **112** (FIG. **32**) defining a proximal end of recess **110**. When finger **108** engages wall **112**, further distal movement of slide block **52** will also effect distal movement of knife actuating bar **44**. As will be evident below, this arrangement allows for staples to be ejected from SULU **18** prior to cutting of tissue.

Referring to FIGS. **12** and **12**A, cam bar **46** includes a pair of sidewalls **114** and a base wall **116**. The proximal end **114***a* of each sidewall **114** includes a raised wall portion **118**. Each raised wall portion **118** is configured to be fixedly received in a slot (not shown) formed in an underside of slide block **52** to fixedly secure the proximal end of cam bar **46** to slide block **52**. Alternately, slide block **52** may be molded about the proximal end of knife actuating bar **44**. The distal end of each sidewall **114** includes an angled camming surface **114***b*. Base wall **116** defines a distally extending elongated slot **123** which extends from the distal end of cam bar **46** along a substantial length of the cam bar **46** and a proximally extending longitudinal slot **121**. Slot **121** is positioned to facilitate the passage of pedal **54** through cutout **55** of channel member **22** when slide block **52** is in the retracted position (see FIG. **27**).

Sidewalls **114** of cam bar **46** are slidably positioned in slots **70***a* and **70***c* of guide block **48** and knife actuating bar **44** is slidably positioned in longitudinal slot **70***b* of guide block **48**. When firing assembly **20** is supported in channel member **22** and firing lever **50** is pivoted to one side of stationary housing **26** and pushed distally, slide block **52** is moved distally within stationary housing **26**. As slide block **52** begins to move distally, tapered surface **86** of pedal **54** engages a proximal edge of channel member **22** defining cutout **55** to urge pedal **54** upwardly out of cutout **55**, through slot **121** of cam bar **46**, and onto an inner surface of stationary housing **26** of firing assembly **20** (FIG. **27**). As this occurs, pin **88** of pedal **54** moves into a stop recess **94***a* to prevent further pivotal movement of firing lever **50**. If firing lever **50** is not pivoted to a position in which pin **88** is positioned beneath a stop recess **94***a*, pedal **54** will be prevented from moving upwardly out of cutout **55** and firing lever **50** will be prevented from moving through a firing stroke. As firing lever **50** is moved distally, finger **108** moves within recess **110** such that knife actuating bar **44** remains stationary as cam bar **46** is advanced distally. When finger **108** engages proximal wall **112** defining recess **110**, knife actuating bar **44** is moved distally with slide block **52** and cam bar **46**. As will be discussed below, when cam bar **46** and knife actuating bar **44** are moved distally within stationary housing **26** of firing assembly **20** and channel member **22**, angled camming surfaces **114***b* of cam bar **46** are moved through SULU **18** to eject fasteners from SULU **18**. Simultaneously, although with a preset delay equal to the length of recess **110** (FIG. **32**), knife actuating bar **44** drives a knife blade **40** through SULU **18** to dissect tissue.

U.S. Pat. No. 7,631,794 ("the '794 patent") discloses a surgical fastener applying apparatus which includes a firing assembly similar to that described above. The '794 patent is incorporated herein by reference in its entirety.

FIGS. **13**-**17** illustrate SULU **18**. Referring to FIG. **17**, SULU **18** includes a body **120**, a plurality of staple pushers **122** (only one is shown), a bottom cover **124**, a knife **40** having an angled sharpened leading edge or blade **40***a*, a plurality of staples **126** (only one is shown), and a pivotally mounted safety lockout **128**. A proximal end of body **120** includes a flexible finger **120***a* which projects slightly beyond the outer wall defining body **120** (see also FIG. **5**). Finger **120***a* frictionally engages an inner wall of channel member **22** to retain the proximal end of SULU **18** within channel member **22** when SULU **18** is releasably positioned within channel member **22**. As is known in the art, body **120** has a plurality of rows of staple retaining slots **130**, e.g., four, six, etc. and a linear slotted knife track **132** centrally disposed in body **120**. Surgical stapler **10** can be dimensioned to receive or accommodate SULU's of different staple line lengths including, e.g., 60 mm, 80 mm and 100 mm. Knife **40** includes a downturned hook portion **40***b* which is positioned to engage upturned hook portion **106** (FIG. **12**) of knife actuating bar **44** when SULU **18** is positioned within channel member **22**.

In the illustrated embodiment, body **120** includes two staggered rows of slots **130** formed on either side of linear slotted knife track **132**. The staggered rows of slots **130** extend beyond the distal end of knife track **132** to facilitate staple formation beyond the distal end of the stroke of the knife blade **40**.

Staple pushers **122** may be configured to extend into one or more slots **130**. In one embodiment, a single pusher is associated with each slot **130**. Alternately, as illustrated in FIG. **17**, each pusher **122** can be configured to extend into two adjacent slots **130** and is positioned beneath respective staples **126** which are retained in slots **130**. As is known in the art, each pusher **122** includes a lower cam surface **122***a* which is positioned to engage one of cam surfaces **114***b* (FIG. **12**) on the distal end of cam bar **46** such that movement of cam bar **46** through SULU **18** sequentially lifts each respective pusher **122** within its respective slot or slots **130** to eject staples from slots **130**.

Bottom cover **124** partially encloses a channel **125** (FIG. **18**) formed within the cartridge body **120**. A longitudinal ridge **134** is formed on an upper surface of bottom cover **124** and provides a bearing surface for a knife supporting member **136** which is secured to a bottom edge of knife **40**. Knife **40** may be secured to supporting member **136** via pins, welding or other known fastening techniques. During a firing stroke, knife **40** is guided along knife track **132** as the firing lever **50** is advanced through channel member **22**. A pair of slots **138** are defined between the sides of ridge **134** and an outer wall of cartridge body **120**. Longitudinal ridge **134** is positioned within body **120** and dimensioned to be slidably received in elongated slot **120** (FIG. **12**A) of cam bar **46** such that cam bar **46** is slidably movable through cartridge body **120** about longitudinal ridge **134** to eject staples **126** from SULU **18**.

Safety lockout **128** is pivotally disposed on an upper proximal end of body **120** and is pivotal about a pivot member **150** from a locked orientation (FIG. **26**) to unlocked orientation (FIG. **34**). Pivot member **150** is received in openings **154** in body **120**. A biasing member, e.g., spring **152**, is positioned between knife supporting member **136** and safety lockout **128** to urge safety lockout **128** towards the unlocked orientation. Safety lockout **128** includes a proximal hook **156** which is positioned to receive an engagement member **158** formed on the knife **40** to retain the safety lockout **128** in the locked orientation when the knife **40** is in the retracted position (FIG. **19**). When the knife **40** is moved towards the advanced position during a firing stroke, engagement member **158** is moved away from proximal hook **156** to allow safety lockout **128** to pivot towards the unlocked position in response to the urging of spring **152**. It is noted that safety lockout **128** is prevented from pivoting to the unlocked position when the anvil half-section **12** and cartridge receiving half-section **14** are in the clamped position because the top surface **128***a* of safety lockout **128** engages an inner surface of anvil half-section **12** to prevent pivoting of safety lockout **128**. Safety lockout **128** defines a slot **160** dimensioned to slidably receive the knife **40**. In the retracted position of the knife **40**, the leading edge **40***a* of knife **40** is confined within slot **160** safety lockout **128** to prevent accidental engagement and injury to medical personnel with leading edge **40***a* of knife **40**.

Referring again to FIGS. **2-3**, anvil half-section **12** includes a proximal handle portion **12***a* and a distal anvil portion **12***b*. Anvil portion **12***b* includes a staple deforming portion **198** which, as known in the art, includes a plurality of staple deforming recesses and faces a top surface of SULU **18** when SULU **18** is positioned in the channel member **22**. As is also known in the art, the staple deforming portion **198** includes a central longitudinal slot (not shown) for receiving the knife **40** as the knife **40** is moved through the SULU **18**. The staple deforming portion **198** can be formed integrally with anvil half-section **12**, or in the alternative, secured to anvil half-section **12** by a fastening process such as welding. A pair of locating fingers **170** (FIG. **3**) are positioned adjacent the proximal end of the staple deforming portion **198** of anvil portion **12***b*. Locating fingers **170** are received in grooves in SULU **18** to properly align SULU **18** with staple determining portion **198** when the apparatus is in a clamped position.

A central portion of anvil half-section **12** includes a pair of cylindrical lateral support members **172**. During assembly of anvil half-section **12** and cartridge receiving half-section **14**, lateral support members **172** are supported in U-shaped recesses **174** defined in a central portion **173** of cartridge receiving half-section **14** (FIG. **28**). A distal wall of central portion **173** defines a tissue stop (FIG. **3**). Lateral support members **172** are also positioned to be received in cutouts **176** formed on spaced flange portions **178** of clamping lever **16** when the clamping lever **16** is moved to the clamped position. Proximal handle portion **12***a* is ergonomically formed and includes a thumb-engaging abutment **180** and a gripping portion **182**. A proximal end of handle portion **12***a* includes a downwardly extending finger **184** which includes a pair of opposed teardrop shaped protrusions **186** which will be discussed in further detail below. Alternately, protrusions **186** may assume a variety of configurations.

Cartridge receiving half-section **14** includes spaced centrally disposed U-shaped recesses **174** positioned to support lateral support members **172** of anvil half-section **12**. The proximal end of cartridge receiving half-section **14** includes a pair of vertical support members **188**. Each vertical support member **188** includes an elongated vertical slot **188***a* having a rounded bottom surface. Vertical slots **188***a* are dimensioned to receive protrusions **186** formed on finger **184** of anvil half-section **12** (FIG. **21**) when the anvil half-section **12** is supported on the cartridge receiving half-section **14** during assembly. By positioning protrusion **186** within the vertical slots **188***a*, anvil half-section **12** can be pivoted in a scissor-like manner with respect to the cartridge receiving half-section **14** between open and closed positions. In one embodiment, protrusions **186** have a teardrop profile. At least one sidewall of cartridge receiving half-section **14** includes a depression **189** (see FIG. **3**) which will be discussed in further detail below.

Clamping lever **16** also includes a handle portion **190** including a grip **190***a* and a thumb engaging abutment **192**. As discussed above, a pair of spaced flange portions **178** are supported on the distal end of clamping lever **16**. Each flange portion **178** defines a cutout **176** dimensioned to receive a respective lateral support member **172** of anvil half-section **12** when stapler **10** is moved towards clamped position (FIG. **2**B). The distal end of clamping lever **16** also defines a pair of openings **194** which are dimensioned to receive a pivot member **187**. Pivot member **187** is dimensioned to extend through openings **195** in cartridge receiving half-section **14** and openings **194** in clamp lever **16** to pivotally secure clamp lever **16** to cartridge receiving half-section **14**.

As shown in FIG. **3**A, an inner wall of clamping lever **16** includes a protrusion **201**. Protrusion **201** is positioned within depression **189** (FIG. **2**A) formed in the sidewall of cartridge receiving half-section **14** to releasably retain clamp lever **16** from moving counterclockwise (as viewed in the orientation of FIG. **3**) to an angled position for cleaning and/or where it can be disengaged from cartridge receiving half-section **14** as explained below.

In order to load firing assembly **20** into proximal portion **24***b* of channel member **22**, the stationary housing **26** of firing assembly **20** is slid into the channel member **22** through the proximal end of channel member **22** until pivot members **29** are received in recesses **30** formed in the proximal end of channel member **22**. After firing assembly **20** is loaded, the SULU **18** can be loaded into distal portion **24***a* in the manner discussed above.

Referring to FIGS. **2** and **2**B, after SULU **18** and firing assembly **20** are loaded into channel member **22**, anvil section **12** can be assembled to cartridge receiving half-section **14**. To attach anvil half-section **12** to cartridge receiving half-section **14**, protrusions **186** of fingers **184** are positioned in vertical slots **188***a* of vertical support member **188** of cartridge receiving half-section **14**. Thereafter, anvil half-section **12** is rotated towards cartridge receiving half-section **14** to position lateral supports members **172** in U-shaped recesses **174**.

In order to position surgical stapler **10** in the clamped position, clamping lever **16** is rotated in a counter-clockwise direction from the position shown in FIG. **2**A. As clamping lever **16** is rotated, lateral support members **172** are received in cutouts **176** (FIG. **2**) of flange portions **178** and cammed towards cartridge receiving half-section **14**. As shown in FIG. **3**, a spring member **200** is secured to an inner surface of clamping lever **16**, such as by welding, at a position to engage cartridge receiving portion **14** to urge clamping lever **16** to the non-clamped position shown in FIG. **2**A. In the clamped position shown in FIG. **1**, the staple deforming portion **198** is positioned in close approximation with the top surface of SULU **18**.

Referring to FIGS. **3**, **3**A and **12**, as discussed above, a pivotal locking member **206** is pivotally supported on the proximal end of stationary housing **26** of firing assembly **20**. Pivotal locking member **206** includes pivot members **29** which extend through openings **28** defined in stationary housing **26**. A finger engagement member **212** is positioned on one end of locking member **206** and a latch portion **210** is positioned on the other end of locking member **206**. Latch portion **206** includes a hook member **210***a*. A biasing member **214** is positioned about a pivot member **29** to urge latch portion **210** inwardly towards stationary housing **26** of firing assembly **20**. When locking member **206** is secured on firing assembly **26**, latch portion **210** extends downwardly through an opening **216** in a proximal end of stationary housing **26** to a position below a bottom surface of channel member **22** (FIG. **20**). As discussed above, the ends of pivot members **29** are received in cutouts **30** formed in the proximal end of cartridge receiving half-section **14** to releasably secure firing assembly **20** within proximal channel portion **24***b* of channel member **22** (FIG.

21). Cutouts **30** are partially defined by downturned fingers **220** to retain firing assembly **26** within channel member **22** (FIG. **3**).

Referring to FIG. 3A, a proximal end of clamping lever **16** includes an engagement member, e.g., cylindrical transverse post **218**, which is positioned to be engaged by hook member **210***a* of latch portion **210** when the clamp lever **16** is moved to the clamped position (FIG. **27**). Although a post is illustrated, other engagement member configurations are envisioned. As can be seen by viewing FIG. **27**, as clamping lever **16** is moved towards the clamped position, an angled face **222** of latch portion **210** engages post **218**. This engagement causes locking member **206** to pivot about pivot members **29** such that hook member **210***a* of latch portion **210** passes by and then snaps into engagement with post **218**. To release latch portion **210** from post **218**, engagement member **212** of locking member **206** is depressed to pivot latch portion **210** out of engagement with post **218**. When this occurs, spring member **200** urges clamping lever **16** to the unclamped position.

Referring to FIGS. **3**, **12**, **19** and **26**, as discussed above, guide block **48** is pivotally supported in stationary housing **26** of firing assembly **20**. Guide block **48** includes a distally extending nose portion **220** (FIGS. **12** and **26**) which rests beneath SULU **18** when SULU **18** is supported in channel member **22**. The internal surface of guide block **48** includes locking surfaces **222** (FIG. **19**) which are received in notches **49** and **51** of knife actuating bar **44** when the stapler **10** is in an unclamped position. When the SULU **18** is positioned in the channel member **22**, prior to moving clamp lever **16** to the clamped position, SULU **18** is positioned atop nose portion **220** and is not fully seated in the channel member **22**, as discussed above. When the stapler **10** is moved to the clamped position, locating fingers **170** (FIG. **3**) engage a top surface of body **120** of SULU **18** to fully seat SULU **18** in channel member **22**. As discussed above, locating fingers **170** are received in grooves in SULU **18** to properly position SULU **18** in relation to anvil portion **12***b*. As SULU **18** is fully seated in channel member **22**, SULU **18** presses downwardly on nose portion **220** of guide block **48** to pivot guide block **48** about protrusions **72**. When guide block **48** pivots, locking surfaces **222** move from notches **49** and **51** to unlock knife actuating bar **44** (FIG. **26**). This configuration prevents movement of the knife actuating bar **44** in relation to guide block **48** prior to clamping to ensure that the knife actuating bar **44** and SULU knife **40** remain properly positioned for operational engagement prior to use.

Referring to FIGS. **24-28**, when stapler **10** is in the clamped, unfired position, slide block **52** of firing assembly **20** is in the retracted position at the proximal end of channel member **22** and stationary housing **26**. See FIG. **27**. In this position, pedal **54** is positioned in cutout **55** of channel member **22** and pin **88** of pedal **54** is positioned in arcuate recess **94** of firing lever **50** beneath stop recesses **94***a*. As such, firing lever **50** can be pivoted to facilitate actuation of stapler **10** from either side of the stapler **10**. In addition, in this position of slide block **52**, finger **108** of knife actuating bar **44** is positioned adjacent the distal wall of recess **110** of slide block **52**. Latch portion **210** of locking member **206** is also engaged with post **218** to retain clamping lever **16** in the clamped position.

Referring to FIG. **26**, when slide block **52** is in the retracted position, knife **40** and cam surfaces **114***b* of cam bar **46** are positioned in the proximal end of SULU **18** and, proximal hook **156** of safety lockout **128** is positioned in engagement with engagement member **158** of knife **40** to retain safety lockout **128** in the locked orientation. In addition, downturned hook portion **40***b* of knife **40** is engaged with upturned hook portion **106** of knife actuating bar **44** to connect firing assembly **20** to knife **40** of SULU **18**.

Referring to FIGS. **29-32**, when the firing lever **50** is advanced distally in the direction indicated by arrow "A" in FIG. **29**, slide block **52** is moved distally within stationary housing **26** of firing assembly **20** to effect corresponding movement of cam bar **46** and delayed movement of knife actuating bar **44**. As discussed above, the delayed movement of the knife actuating bar **44** is equal to the length of recess **110** of slide block **52** and results from movement of finger **108** of knife actuating bar **44** within recess **110** of slide block **52**. Movement of knife actuating bar **44** with slide block **52** begins when finger **108** abuts the proximal wall **112** of recess **110**. As cam bar **46** is moved distally through stationary housing **26** of firing assembly **20**, cam surfaces **114***b* on sidewalls **114** of cam bar **46** are advanced through SULU **18** to sequentially engage pushers **122** to eject staples **126** from slots **130** of body **120**. Concurrently, since the distal end of knife actuating bar **44** is engaged with knife **40**, knife **40**, after the preset delay, is advanced through SULU **18** to incise tissue between the staple lines.

As shown in phantom in FIG. **32**, when slide block **52** moves distally within stationary housing **26**, pedal **54** rides up over channel member **22** and moves along inner surface of stationary housing **26** of firing assembly **20**. When this occurs, pin **88** of pedal **54** moves into a stop recess **94***a* to prevent further pivotal movement of firing lever **50**.

Referring to FIGS. **31** and **32**, when knife **40** is moved distally within SULU **18**, engagement member **158** of knife **40** is disengaged with proximal hook **156** of safety lockout **128**.

Referring to FIGS. **33** and **34**, when the firing lever **50** is returned to its proximal-most position to retract cam bar **46** and knife **40**, and the locking member **206** is depressed to disengage latch portion **210** from post **218**, spring **200** urges clamping lever **16** to its unclamped position to allow stapler **10** to move to the open position. In the open position, anvil half-section **12** is spaced from cartridge receiving half-section **14** and spring **152** (FIG. **17**) pivots safety lockout **128** in the direction indicated by arrow B in FIG. **34** about pivot member **150** to its unlocked position such that safety lockout **128** projects upwardly from SULU **18**. In the unlocked position, safety lockout **128** prevents movement of the stapler **10** back to the clamped position. In order to reuse stapler **10**, used SULU **18** must be replaced with a new SULU **18**.

During a surgical procedure, SULU **18** can be replaced multiple times to facilitate multiple uses of stapler **10** on a single patient. If an integrated unit is provided, the SULU and firing assembly can be replaced multiple times. Since each SULU **18** is provided with a fresh knife **40**, tearing of tissue is minimized. After the surgical procedure, the used SULU(S) **18** and the firing assembly **20** can be removed from the channel member **22** and disposed of in an appropriate manner. The anvil half-section **12**, cartridge receiving half-section **14** and clamping lever **16** can now be sterilized, such as by autoclaving, and reused with a new SULU **18** and firing assembly **20** in the manner discussed above. Because the locking member **206** forms part of the firing assembly **20** and is disposable, fewer areas remain on the reusable components for tissue and fluids to become trapped. As such, the reusable components of the apparatus can be more easily sterilized. Note for cleaning/sterilization, the clamping lever **16** can be rotated clockwise from the position of FIG. **2**A so the protrusion **201** is out of engagement with the depression **189** of cartridge receiving half-section and the clamping lever **16** moved to a greater angle with respect to cartridge receiving half-section **14**, e.g., about 90° or even an obtuse angle. This facilitates cleaning/sterilization. In some embodiments, once rotated out of depression **189**, the clamping lever **16** can be separated from the cartridge receiving half-section **14**.

It will be understood that various modifications may be made to the embodiments of the surgical fastener applying apparatus disclosed herein. Therefore, the above description should not be construed as limiting, but merely as exemplifications of embodiments. Those skilled in the art will envision other modifications within the scope and spirit of the present disclosure.

What is claimed is:

**1**. A surgical fastener applying apparatus comprising:

an anvil half-section including a distal anvil portion and a proximal handle portion;

a cartridge receiving half-section defining an elongated channel member, the elongated channel member having a distal portion dimensioned to releasably receive a single use loading unit and a proximal portion configured to support a firing assembly,

a clamping lever secured to the cartridge receiving half-section, the clamping lever having a proximal portion and a distal portion and including a handle portion supporting an engagement member; and

a firing assembly configured to be releasably supported within the proximal portion of the cartridge receiving half-section and including a stationary housing releasably received within the proximal portion of the cartridge receiving half section, a firing lever, a cam bar fixedly secured to the firing lever, and a pivotal locking member including a latch portion, the pivotal locking member being pivotally supported on a proximal end of the stationary housing;

the clamping lever being operably associated with the anvil half-section and the cartridge receiving half-section and being movable from an unclamped position to a clamped position to releasably secure the anvil portion of the anvil half-section in close approximation with the single use loading unit, wherein in the clamped position, the engagement member of the clamping lever releasably engages the latch portion of the locking member to releasably retain the clamping lever in the clamped position.

**2**. The surgical fastener applying apparatus according to claim **1**, wherein the engagement member includes a cylindrical post.

**3**. The surgical fastener applying apparatus according to claim **1**, wherein the locking member includes a pair of pivot members which are pivotally supported in openings defined in a proximal end of the stationary housing of the firing assembly.

**4**. The surgical fastener applying apparatus according to claim **2**, wherein the latch portion includes a hook member engageable with the engagement member of the clamping lever.

**5**. The surgical fastener applying apparatus according to claim **1**, further comprising a finger engagement member positioned on the locking member, wherein the finger engagement member is depressed to release the latch portion from the engagement member of the clamping lever.

**6**. The surgical fastener applying apparatus according to claim **5**, wherein the finger engagement member is positioned proximal of the firing lever.

**7**. The surgical fastener applying apparatus according to claim **5**, wherein the finger engagement member is positioned on one end of the locking member and the latch portion is positioned on the other end of the locking member.

**8**. The surgical fastener applying apparatus according to claim **3**, wherein the elongated channel member has first and second cutouts to receive the pivot members to releasably secure the firing assembly within the proximal portion of the channel member.

**9**. The surgical fastener applying apparatus according to claim **8**, wherein the cutouts are partially defined by fingers.

**10**. The surgical fastener applying apparatus according to claim **1**, wherein the firing assembly and single use loading unit are disposable and the anvil half-section, cartridge receiving half-section and clamping lever are reusable.

**11**. The surgical fastener applying apparatus according to claim **1**, further comprising a biasing member urging the latch portion inwardly towards the stationary housing.

**12**. The surgical fastener applying apparatus according to claim **1**, wherein the latch portion extends through an opening in the proximal end of the stationary housing and below a bottom surface of the elongate channel member.

**13**. The surgical fastener applying apparatus according to claim **1**, further including a spring member which is supported on the clamping lever and positioned to engage the cartridge receiving half-section to urge the clamping lever to the unclamped position.

**14**. The surgical fastener applying apparatus according to claim **3**, wherein the stationary housing includes a U-shaped frame including a bottom wall and a pair of sidewalls, each of the sidewalls having a proximal end defining the openings, the pivot members extending through the openings at a position to be received in cutouts in a proximal end of the cartridge receiving half-section to releasably retain the stationary housing within the proximal portion of the elongated channel member.

**15**. The surgical fastener applying apparatus according to claim **1**, wherein the firing assembly further includes a knife actuating bar which is configured to engage a knife supported within the single use loading unit.

**16**. The surgical fastener applying apparatus according to claim **1**, wherein the firing assembly further includes a guide block axially fixed within the U-shaped frame and a slide block slidably positioned with the U-shaped frame, wherein the firing lever is pivotally secured to the slide block and the cam bar is fixedly secured to the slide block, the slide block being slidable through the U-shaped frame to advance the cam bar through the distal portion of the elongated channel member.

**17**. The surgical fastener applying apparatus according to claim **1**, wherein the cartridge receiving half-section includes a sidewall defining a depression and the clamping lever includes a sidewall defining a protrusion, the protrusion being positionable within the depression to retain the clamping lever.

**18**. The surgical fastener applying apparatus according to claim **17**, wherein the clamping lever is releasably secured to the cartridge receiving half-section, the clamping lever movable to move the protrusion out of engagement within the depression to enable detachment of the clamping lever from the cartridge receiving half-section.

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